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ABSTRACT

The proceedings of the fifth symposium on mountain and survival medicine include the program for the 4-day conference which was addressed by 21 guest lecturers from Canada, Nepal, and the United States. The proceedings include abstracts for and background information on the authors of 17 papers. It also includes the texts of 13 symposium papers: "Principles and Practice of First Aid," Dick Mitchell; "Legal Aspects of Mountaineering First Aid," Mike Green and Bill Rives; "Cardiovascular Adjustments of Physical Conditioning," Loring B. Rowell; "Expedition Travel and Your Health," Dr. Peter Steele; "Summary of Treatment of the Cold Injured Patient," Dr. William J. Mills, Jr.; "The Incidence and Importance of Acute Mountain Sickness," Peter Hackett; "Acute Mountain Sickness and High Altitude Cerebral Edema," Dr. Drummond Rennie; "HAPE - High Altitude Pulmonary Edema," Dr. Herbert Hultgren; "Heat Illness," Dr. Robert S. Mecklenburg; "Clothing and Equipment for Extreme Environments," Dr. Ralph F. Goldman; "Putting Survival Into Perspective," Robert Stoffel; "Survival Medicine," Gene Fear; and "Current Trends in Search and Rescue Missions," Patrick LaValla. The publication includes reprints of eight articles originally published in the 1975 Mountain Medicine Symposium proceedings. The articles deal with the care of accident victims, rescue, treatment of cold injuries, food and survival, search, heat survival, and heat syndromes. (SB)

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MOUNTAIN MEDICINE SYMPOSIUM PAPERS

Prepared for Publication by
Dick Mitchell
Patrick LaValla
Gene Fear

This collection of papers and the four-day seminar on Mountain Medicine have been accomplished because of a cooperative effort between two men:

Through the dedication of Dick Mitchell for improving the skills and technical medical knowledge of outdoorsmen who frequent the high country of the world,

and

Patrick LaValla of Washington State Department of Emergency Services, who has the position of Assistant Director in charge of coordinating Search and Rescue within Washington State, and Public Outdoor Safety Education. His goal is providing awareness information regarding all facets of medical and technical support to SAR teams in Total Emergency Response.

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The conference was held in a beautiful wooded conference center located at Issaquah, Washington. The location was chosen because of its close proximity to the airport and the large population of outdoorsmen in the Puget Sound Megalopolis.

The conference site provided adequate lodging, good food, and ample space for handling the large group of interested hikers, climbers, doctors, and physicians.

Evening entertainment ranged from dramatic Big Wall rescues in Yosemite, climbs of Mt. McKinley, social parties for all, to a lengthy evacuation of a C-141 aircraft from Olympic National Park.

For those who could attend, it was a special four days of learning valuable information from those most knowledgeable on the subject.

The four day medical program of lectures, displays and workshops was designed to provide the latest information needed to cope with common medical problems and to initiate treatment in remote , high, and often hazardousenvironments

The 21 guest lecturers were brought to the conference from throughout the United States, Canada, and Nepal. They were chosen because they were the foremost experts in their respective fil fields .

TABLE OF CONTENTS

	Page
Program	3
Introduction	7
Speakers and Abstracts	9
Principles and Practice of First Aid Dick Mitchell	20
Legal Aspects of Mountaineering First Aid Mike Green and Bill Rives	30
Cardiovascular Adjustments of Physical Conditioning Loring B. Rowell	35
Expedition Travel and Your Health Dr. Peter Steele	38
Summary of Treatment of the Cold Injured Patient William J. Mills, Jr., M.D.	48
The Incidence and Importance of Acute Mountain Sickness Peter Hackett	53
Acute Mountain Sickness and High Altitude Cerebral Edema Drummond Rennie, M.D.	55
HAPE - High Altitude Pulmonary Edema Berbert Hultgren, M.D.	65
Heat Illness Robert S. Mecklenburg, M.D.	71
Clothing and Equipment for Extreme Environments Ralph F. Goldman, Ph.D. U.S. Army Research Institute of Environmental Medicine	77
Putting Survival Into Perspective Robert 'Skip' Stoffel	81

CONTENTS

	Page
Survival Medicine Gene Fear	35
Current Trends in Search and Rescue Missions - or The Most Successful Search and Rescue Mission Is The One That Never Had to Happen Patrick 'Rick' LaValla	89
Yosemite Institute Proceedings Reprint	
Complete Care of the Accident Victim Cameron Bangs, M.D.	93
Rescue Dick Mitchell	96
Early Recognition and Treatment of Cold Injuries Cameron Bangs, M.D.	97
Food and Survival Jean A. Syrotuck	103
Search William Syrotuck	108
Heat Survival Jean A. Syrotuck	109
Heat Syndromes Jean A. Syrotuck	111
Rescue and Search William Syrotuck	113

MOUNTAIN MEDICINE SYMPOSIUM PROGRAM

FIRST DAY

Registration		Lobby
Introductory Remarks	Dick Mitchell	Main Auditorium
Physical Conditioning	Loring Rowell	Main Auditorium
Break		
Accident Prevention & Response	Dick Mitchell	Main Auditorium
Psychological Aspects of Emergencies	Ed Rynearson	Main Auditorium
Lunch		Main Dining Room
First Aid	Lothar Pinkers	Main Auditorium
Legal Aspects of First Aid	Mike Green & Bill Rives	Main Auditorium
Break		
Panel Discussion "Conflicts in first Aid"	Lothar Pinkers (moderator) Cameron Bangs Mike Green Bill Rives Peter Steele	Main Auditorium
Dinner		Main Dining Room
Evening Program "C-141 Disaster-- Winter Search & Rescue"	Tony Anderson Olympic National Park	Main Auditorium
Hospitality Party		Lounge III

MOUNTAIN MEDICINE SYMPOSIUM PROGRAM

SECOND DAY

Second Aid	Lothar Pinkers	Main Auditorium
Break		
Mountain Miseries	Peter Steele	Main Auditorium
Frostbite	Bill Mills	Main Auditorium
Lunch		Main Dining Room
Hypothermia	Cameron Bangs	Main Auditorium
Panel Discussion "First Aid Kits & Drugs"	Bob Mecklenburg (moderator) Mike Green Lothar Pinkers Bill Rives Jerry Sabel Tom Sawyer Peter Steele	Main Auditorium
Group Discussions	Lothar Pinkers	Room 215
First & Second Aid	Bob Mecklenburg	Room 216
First Aid Kits	Cameron Bangs &	Room 214
Frostbite & Hypothermia	Bill Mills	
	Loring Rowell	Room 213
Physical Conditioning	Mike Green &	Room 212
Legal Aspects	Bill Rives	
Medical Aspects-Group Discussion (Physicians Only)	Cameron Bangs (moderator)	Room 214
Barbecue		
Evening Program "Bicentennial Denali Expedition"	Dick Mitchell	Main Auditorium

MOUNTAIN MEDICINE SYMPOSIUM PROGRAM

THIRD DAY

Acute Mountain Sickness	Peter Hackett	Main Auditorium
Break		
Cerebral Edema (CE)	Drummond Rennie	Main Auditorium
High Altitude Pulmonary Edema	Herb Hultgren	Main Auditorium
Lunch		Main Dining Room
Heat Illness	Bob Mecklenburg	Main Auditorium
Clothing and Equipment	Ralph Goldman	Main Auditorium
Break		
Food & Nutrition	Nathan Smith	Main Auditorium
Group Discussions		
Mountain Sickness & CE	Peter Hackett & Drummond Rennie	Room 214
HAPE	Herb Hultgren	Room 213
Mountain Miseries	Peter Steele	Room 212
Clothing & Equipment	Ralph Goldman	Room 215
Food & Nutrition	Nathan Smith	Room 216
Dinner		Main Dining Room
Evening Program		
"Big Wall Rescues in Yosemite"	Pete Thompson Mt. Rainier National Park	Main Auditorium

MOUNTAIN MEDICINE SYMPOSIUM PROGRAM

FOURTH DAY

Survival & Survival Medicine	Skip Stoffel & Gene Fear	Main Auditorium
Search & Rescue	Rick LaValla Greg McDonald	Main Auditorium
Summary Session	Group Discussions (involving all conferees)	To Be Announced
Summary Session	Panel Response (involving all conferees and speakers)	Main Auditorium
Lunch		Main Dining Room

INTRODUCTION

by Dick Mitchell

This Symposium is the fifth of its kind. The first was held in December, 1973, in London when a few dozen veteran Himalayan climbers were brought together to reminisce and discuss new developments in high altitude survival. So successful was this small gathering that a large meeting was held in Wales in March, 1975. Here a group of distinguished scientist discussed what they knew about high altitude and exercise physiology. The Wales meeting lasted two days and was primarily for scientists. The proceedings were published by The Alpine Club of London under the title "Mountain Medicine & Physiology."

Unlike the two British meetings, in October of the same year, The Yosemite Institute--a non-profit organization devoted to environmental education--conducted a symposium to cover more than high altitude and exercise physiology. Planned by Dr. Charlie Houston, who had attended the two previous symposia, it included a wide range of medical problems likely to be encountered in the mountains and discussed those in terms which non-medical persons could easily share. It was not a medical meeting where doctors talk to doctors--nor a training program where instructors lecture and demonstrate to students--but rather a sharing of experience where the essentials were laid out by experts for discussion by all. The Yosemite Symposium lasted four days and was attended by 250 people--most of whom were non-medical.

In April, 1976, another Symposium was held, again planned by Dr. Charlie Houston. This time the setting was Banff, Alberta, Canada conducted jointly by The Yosemite Institute and The Arctic Institute of North America. The Symposium was generally conducted as had been the one in Yosemite with 175 attending.

And now this Symposium. Charlie and I were convinced that Seattle would be a perfect place to hold the next one--because of the large enthusiastic climbing population and because within a few hours of Seattle, are located a number of professionals who are the most knowledgeable individuals in their field in the Nation.

This Symposium, developed through the cooperation of The Washington State Department of Emergency Services, will be conducted similar to the previous symposia except for some expansion to include topics such as survival, search and rescue, clothing and equipment, and legal and training aspects of mountain medicine. Our objectives are simple: to spread knowledge and practical applications of the many aspects of mountain medicine and backcountry safety to persons who go into the mountains for enjoyment or who go to assist the sick and injured. The emphasis, as always, will be on an exchange of ideas through group discussion rather than pure lecture.

I am proud to chair this Symposium. I think that, at its conclusion, you will agree with me that this has been the most outstanding and informative meeting of its kind ever conducted.

Again, welcome. I hope you enjoy and benefit from the next four days.

TOPIC Legal Aspects of First Aid

SPEAKERS Mike Green and Bill Rives

Michael R. Green, partner in the law firm of Davis, Wright, Todd, Riese and Jones, Seattle. Extensive experience as a trial lawyer in the field of medical malpractice.

William Rives, associate in Davis, Wright, Todd, Riese & Jones, Chairman of the Legal Advisory Committee of The Mountaineers.

ABSTRACT

The legal consequences of administering first aid to persons injured in climbing accidents is a subject which has received little attention but is one that climbers should be aware of because of the potential personal liability involved. Depending upon the circumstances, if first aid is not properly administered, the injured person, or his heirs if he should die, may be successful in a suit for damages against the rescuers. The symposium discussion will consider the various kinds of suits that may be brought by an injured climber, the standards of care required in rendering first aid, and means of avoiding liability from first aid administered in the mountains.

THE FOLLOWING PAGES GIVE A BRIEF OVERVIEW OF THE SPEAKERS AND THEIR CREDENTIALS ALONG WITH AN ABSTRACT OF THEIR PRESENTATION TO THE GROUP;

It was impossible to acquire all of the speakers written papers due to time and the many pressures of their respective professions.

The editors have elected to include the abstracts because they contain brief but valuable information on a particular subject and may inspire more individual research by those interested.

TOPIC Accident Response

SPEAKER Dick Mitchell

Medic for The Mountain Rescue Council. American Red Cross Instructor Trainer. EMT. Author of "Mountaineering First Aid". Member of The National Ski Patrol. Established The Mountaineers' first aid program. Climbed throughout The United States and Canada.

ABSTRACT

Preparation for a mountaineering accident begins before the trip by acquiring a working knowledge of how to respond and by choosing equipment that will aid in such response. If an accident does occur, then a series of actions can be performed correctly, completely, and quickly. Not only must bandages and splints be applied, but the anxiety, concern and pain felt by the injured must be attended. The victim must be kept warm and sheltered while the party develops a detailed plan of action. Decisions must be made between immediately evacuating the victim with the party on-hand or delay evacuation until rescue assistance can be obtained. The party must evaluate its and the victim's strengths and needs. They must work together utilizing all equipment and resources efficiently and knowledgeably.

TOPIC Physical Conditioning

SPEAKER Dr. Loring Rowell

Professor, Department of Physiology & Biophysics, and Professor of Medicine (Cardiology), University of Washington School of Medicine. Ph.D. University of Minnesota, Minneapolis, 1962 in Physiology.

ABSTRACT

Mountain travel requires endurance. Endurance is acquired by a process called physical conditioning. This presentation defines what endurance means in physiological as well as practical terms. The physiological process by which physical conditioning changes endurance is described with emphasis on the changes which occur in the heart and circulation to different body regions - and the consequence of these changes to regional metabolism and temperature regulation. Changes in skeletal muscle metabolism are also discussed.

◇ TOPIC First & Second Aid

SPEAKER Dr. Lothar Pinkers

General Surgeon, University of Washington School of Medicine. St. Louis, Missouri and general surgery in The Virginia Mason Hospital and Mason Clinic, Seattle. Private practice 1962. Currently chairman of The Washington State Medical Association Committee on Emergency Medical Technician Training Standards. Backpacker for several years, both for individual recreation and with The Boy Scout Council

ABSTRACT

In the not too distant past, training in first aid was limited to courses offered by The American Red Cross, The Fire Service, Bureau of Mines, and Depts. of Labor & Industries in the various states. People involved in mountaineering would avail themselves of these training opportunities and embellish them by their own experience. There was a need for additional training. Such a need is currently partially being met by The EMT & Paramedic programs in varying degrees around the country. Considerations of training requirements, skill standards, degradation of skills, and involement in man hours, dollar amounts, physician hours, training programs, etc. will be discussed. The understanding of where various points in the spectrum between individual first aid and the physician can be of use in the backcountry will be developed. Contrary to some people's expectations, many of the more advanced skills are not useful in the backcountry, and attempts to learn these skills are non-productive.

◇ TOPIC Psychological Aspects Emergencies

SPEAKER Dr. Ed Rynearson

Department of Medicine, Section of Psychiatry, Adult Psychiatry, The Mason Clinic, Seattle. Received his undergraduate training at Harvard, Psychological training at The Mayo Clinic. Spent one year practicing in New Zealand.

ABSTRACT

The presentation will focus on individual stress and potential inter-party conflict during emergencies that occur in mountaineering. It will represent a clinician's approach to dealing with various situations rather than a theoretical approach.

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TOPIC Mountain Miseries

SPEAKER Dr. Peter Steele
General Physician, trained in surgery & ophthalmology in Britain. Climber, skier. Many mountain trips to Nepal, Pakistan, Bhutan, Afghanistan, South America. Author of "Doctor on Everest" & "Medical Care for Mountain Climbers".

ABSTRACT

The preparations for an expedition include a full medical examination and history. Teeth must be checked. Immunization & prevention are emphasized. Trauma in the event of accident is discussed.
Illnesses are divided into those that occur on the march into the mountain, and those that occur on the mountain. On the hill the illnesses are compounded by the problems of altitude. Insomnia and headaches cause misery; respiratory infections, sore throats, cracked lips and dry coughs are caused by the cold dry air. Bronchitis, cough fractures and spontaneous pneumothorax are more common than at lower levels. Ultra-violet rays cause sunburn and snow blindness. Hemorrhoids are an uncomfortable unpleasantness. Phlebitis is the consequence of viscous blood and inactivity in stormbound situations. Mental problems are exaggerated by the hypoxia of altitude, and have strange effects on appetite and libido. Perhaps stories of the yeti are true after all! The emphasis throughout is on the mundane illnesses that are quite undramatic, but can make all the difference between success or failure of an expedition.

TOPIC Frostbite

SPEAKER Dr. Bill Mills
Orthopedic surgeon in Anchorage Alaska. Consultant in cold injury to the Army Surgeon General. Author of numerous reports and articles on cold injury.

ABSTRACT

In the treatment of frostbite, the following should be accomplished in an absolutely sterile environment:
1 Thaw the limb in warm water ~100-108°F.
2 Restore electrolyte balance & check for acidosis, fat embolism, dehydration, alcoholic coma, concomitant soft-tissue injury, or fracture.
3 Give a tetanus toxoid booster if indicated by associated trauma.
4 Protect thawed part - do not rupture Henle blebs.
5 Maintain bedside isolation with sterile technique during the bleb stage to protect the patient against outside contamination.
6 Consider fasciotomy and sympathectomy if there is distal ischemia.
7 Use whirlpool bath at normal tissue temperature twice a day for 20 minutes.
8 Demand - and get - constant active motion of the digits.
9 Avoid meddling with the wound, early debridement and amputation.
10 Do escharotomy at proper time to permit joint motion.
11 Wait -- the black color may be only skin deep.

◇ TOPIC Hypothermia

SPEAKER Dr. Cameron Bangs

Internist in private practice. Special interest in cold weather survival. Medical Adviser, Mt. Hood Ski Patrol. Search & Rescue Council, State of Oregon. Instructor for National Ski Patrol. Skier and climber.

ABSTRACT

The primary goal of this session will be to discuss the recognition and treatment of hypothermia in the mountain situation. To do this, some of the physiological changes that occur with hypothermia will be presented, primarily those which influence the recognition and treatment. Signs or symptoms of hypothermia will be described and factors influencing the choice of treatment will be discussed.

This discussion will aim, primarily, at chronic hypothermia rather than acute immersion hypothermia and will deal with degrees of hypothermia from mild to severe.

◇ TOPIC Acute Mountain Sickness & Cerebral Edema

SPEAKER Dr. Drummond Rennie

Associate Professor of Medicine, Rush Medical College. Associate Director of Nephrology Section. Two Himalayan expeditions. Research in the effects of high altitude.

ABSTRACT

Acute Mountain Sickness (A.M.S.) is a disease characterized by abnormal shifts of fluid from outside the cells to within the cells and from one part of the circulation to another and in its simple form very commonly encountered by climbers. Its recognition, treatment and prophylaxis will be discussed. Then one of the two really serious complications of AMS, high altitude cerebral edema (CE) will be covered. CE, in its mildest form, is responsible for all the sometimes trivial and sometimes intolerable effects of AMS. There are certain symptoms and signs which suggest that water has flowed into the brain cells enough to cause them to function very poorly indeed. It is important for the climber & the climber's colleagues, to be able to recognize the signs & symptoms and to regard them as an acute emergency which above all requires getting the affected climber down rapidly, giving the rest and oxygen needed.
It will be emphasized that AMS & CE can be prevented by going to high altitudes slowly and resting; by remembering that there is huge individual variation; and by keeping a careful eye on one's colleagues; and when problems do occur, evacuating to lower altitudes IMMEDIATELY (whether or not air evacuation has been promised or is expected).
Throughout, the emphasis will be upon sensible prevention.

◇ TOPIC High Altitude Pulmonary Edema

SPEAKER Dr. Herb Hultgren

Professor of Medicine, Stanford University, Chief of Cardiology Veterans Hospital, Palo Alto, California. Internist, Cardiologist with special interest in high altitude illness. Mountaineer.

ABSTRACT

HAPE occurs in unacclimatized individuals who ascend rapidly to altitudes exceeding 8,000'. HAPE may occur in an altitude resident or sojourner who returns to sea level for more than 2 weeks and again goes to high altitude. The incidence of HAPE varies from 1-6% in altitude exposures above 12,000'. The incidence is higher in: adolescents, those who have had HAPE previously, following heavy exertion, and at higher elevations. Symptoms usually begin on the 2nd to 4th day after arrival & consist of: shortness of breath, fatigue, coughing, & headache. When severe, gurgling sounds in the chest, coughing bloody fluid, blueness of the lips and disturbances of consciousness occur. A comatose patient with HAPE will die within 6-24 hours unless prompt treatment can be applied. Descent with assistance or by litter, & oxygen administration are the most effective treatment. Walking cases may be treated by 1-2 days of bedrest. Drug therapy does not appear to be effective. Diamox may prevent HAPE but is of no value in treatment. If there is a shortness of breath at rest, heart rate 110/min., respiratory rate of 16/min. (at 14,000') or rales (crackles) in the chest, HAPE is likely to be present and descent should be instituted. Acclimatization for 3-4 days at an intermediate altitude, avoidance of heavy physical exertion for 1-2 days after arrival at high altitude & early recognition are important preventive measures.

◇ TOPIC Heat Illness

SPEAKER Dr. Bob Mecklenburg

Physician at The Mason Clinic, Seattle, Wash. Clinical Faculty Member, The University of Wash. Internist, Endocrinologist. Member: Seattle Mountaineers, Mountain Rescue Council.

ABSTRACT

Heat Illness includes the syndromes of heat exhaustion, heat stroke and heat cramps.
Heat loss from the body may occur by radiation, conduction & evaporation. Convection, or air movement across the body surface, increases heat dissipation by conduction & evaporation.
There are two major thermoregulatory mechanisms protecting against overheating (hyperthermia): 1) evaporation of sweat, & 2) dilation of cutaneous blood vessels which allows increased heat loss from the skin. These defenses are controlled by a thermoregulartory center located in the brain.
Heat illness is a threat when rigorous physical activity takes place in an environment where: 1) the ambient temperature exceeds the body temp.; 2) relative humidity is high; &, 3) air movement across the body is minimal.
Heat exhaustion occurs when high environmental temperature results in extreme dilation of skin blood vessels, thereby reducing blood supply to the brain and other vital organs.
Heat stroke occurs when sweating and cutaneous vasodilation fail to dissipate excess body heat.
Heat cramps are painful, involuntary muscle contractions usually percipitated by strenous exercise after profuse sweating.

◇ TOPIC Clothing and Equipment

SPEAKER Ralph F. Goldman, Ph.D.

Director, Military Ergonomics Div., US Army Research Institute of Environmental Medicine, Natick, Mass. Adjunct Professor, Boston University, Lecturer, M.I.T. Physiologist, Bio-Physicist, with special interest in human tolerance limits.

ABSTRACT

There are only two solutions to supporting men in extreme cold environments; increase heat production or decrease heat loss. The physiological mechanisms involved in increasing the load or weight of clothing carried are considered, and, obviously, simply maintaining a high level of working heat production is the simplest solution. Increased work can result from increased clothing weight or inefficient design of clothing, but these do not help a man at rest in the cold. The heat available from shivering is quite limited, if anything useful is to be accomplished. Reduction of heat loss is primarily through provision of insulation; although physiological mechanisms exist, they have quite limited potential for reducing heat loss. Insulation of clothing is related to thickness. Modern developments in clothing concentrate on provision of thickness with minimum weight. Specific fiber selection is relatively unimportant. Keeping moisture from accumulating in clothing is of paramount importance. Reflective materials have both promise & problems in such insulating systems. Respiratory heat exchangers & face masks are considered generally unnecessary, while auxiliary heated handwear & footwear are recommended as highly desireable, but expensive at present.

◇ TOPIC Food and Nutrition

SPEAKER Dr. Nathan Smith

Consultant in Nutrition and Pediatrics in The Sports Medicine Clinic at The University of Washington. Directed The Washington State Component of The National Ten-State Nutrition Survey and served as Nutrition Advisor to the Secretary of HEW in 1970-71. Authored "Food in Sport" for athletes and coaches.

ABSTRACT

The nutritional status of Americans living in a food-excess affluent society will be briefly reviewed. The problems of obesity, caloric deprivation, iron deficiency and supplement abuse will be put in perspective for active lifestyle individuals. The dietary practices advantageous to the alpinist will be discussed including hydration, carbohydrate loading and developing optimal body composition.

TOPIC Current Trends in Search and Rescue

SPEAKER Rick LaValla

Director of Search and Rescue, Washington State Department of Emergency Services. Graduate, National Search and Rescue School. Established the first college accredited S&R Management Course. Instrumental in procuring federal funds for support of state preventive S&R programs. National Association Search and Rescue Coordinators.

ABSTRACT

Search & Rescue missions have been increasing 10-20% over the past six years. Percentages seem to be keeping pace with the increasing numbers of recreationalists venturing away from their "greenhouse environments". Data collected and recorded by The Wash. State Dept. of Emergency Services since 1970 indicates common factors or causes are present in the majority of missions. Analysis shows that mismanagement of the body and a lack of knowledge about internal processes resulting from environmental stress are key reasons.

Fundamentals of outdoor enjoyment for the recreationalist must include an understanding of the following:

- Body management indicators
- Environmental stress effects on the body
- Individual & leadership responsibilites when leaving civilization
- The most common factors which precipitate S&R missions

It is imperative to understand the rules and responsibilities of all factions involved in S&R. The state of the art is advancing rapidly, but must be backed by a sound preventive S&R program for the schools and general public.

TOPIC Search and Rescue -- Evacuation

SPEAKER Greg McDonald

USAF Pararescueman for nine years with service in Europe, SE Asia & The Pacific. Over 2000 hours of rescue helicopter experience. In charge of Standardization & Training, 304th ARRS Pararescue Section; Portland, Oregon for the past four years. Instructor for Wash. State DES in Helicopter Operations, S&R Management & Winter Survival.

ABSTRACT

Procedures for evacuation of a sick or injured person from the mountain environment vary according to time required for performance, ease of transportation & medical expertise available on-scene during the evacuation. Helicopters, because of their obvious advantages in all three of these areas, have come to be the preferred evacuation tool of most rescue mission coordinators. Although the use of a helicopter has shortened the time for delivery of the patient from the mountain to the hospital, the evacuation phase of a rescue mission should not be lightly looked upon. Considerations which rescuers need to apply to evacuation planning include such things as the limitations of the aircraft to be used, the necessity for landing or hoisting and procedure for safe and proper loading of the litter. Patient considerations include such things as completeness of patient medical information and pre-flight patient preparation, including the necessity for an in-place I.V. prior to transport. Hoisting considerations include eye & ear protection & the additional wind-chill factor encountered with rotor wash, in addition to the usual in-flight problems associated with noise, vibration, anxiety, air sickness and rapid changes in altitude.

◇ TOPIC Putting Survival into Perspective

SPEAKER Skip Stoffel

Survival Education Coordinator, State of Washington. Developed and initiated the first full spectrum survival education program for the public schools. Author of "Emergency Preparedness Today" (resource text for teaching survival in the public schools). State Search & Rescue Coordinator. Graduate, National Search & Rescue School. Former Professional Guide and ex-Air Force Global Survival Instructor.

ABSTRACT

There is a need to dispell traditional connotations of survival. The ability to survive is infinitely more complex than merely being able to "live off the land". Statistics prove that nearly all "survival situations" today are typically short term in duration (72 hours or less). Preconceived ideas about survival can precipitate incorrect priorities & actions in the initial moments of stress. Initial decisions have great bearing on the outcome. It is imperative to understand the necessities of life and how they should be prioritized under emergency conditions. Traditional survival skills must be tempered with an understanding of how the human body functions in the face of environmental and mental stress. The responsibility for providing this self-reliance education lies with every individual; especially those who deal regularly with problems so often encountered when individuals are apart from civilization, i.e., S&R volunteers, EMT's and medical personnel involved in mountain medicine, and agencies of government.

◇

TOPIC Survival Medicine

SPEAKER Gene Fear

Experienced outdoorsman, Mountaineer, Volunteer Rescue Team Member, Survival Instructor. Author of "Outdoor Living", "Surviving the Unexpected Wilderness Emergency" and numerous outdoor articles and safety publications

ABSTRACT

In a survival situation, you cannot rely on outside help. Rather, you must take immediate action to sense your body's needs and do whatever is necessary to ensure your own health and safety.

To maintain the body chemical balance, for example, a person should pay attention to the amount of water he drinks and salt he consumes to prevent heat exhaustion. He should stop travelling if a foot feels hot and tape it before a blister occurs. He should rest and prepare shelter before becoming totally exhausted and collapses. If injured, he should be able to dress his own wounds, splint his own broken extremity, or tape an ankle. All of these are things an individual should and can do to cope with unexpected situations.

TOPIC First Aid Kits

PANEL MEMBER Jerry Sabel

Past Chairman, Seattle Mountain Rescue Council. MRC Medic Program Coordinator. Chairman of The Mountain Rescue Association Paramedic Care Committee. American Red Cross Instructor for 16 years and Emergency Medical Technician. Ranger at Mt. Rainier National Park.

TOPIC First Aid Kits

PANEL MEMBER Dr. Tom Sawyer

M.D. with The Northwest Kidney Center. Department of Medicine, University of Washington. Climber.

MOUNTAIN MEDICINE SYMPOSIUM PROGRAM

FIRST DAY
DEVOTED TO

PHYSICAL CONDITIONING

ACCIDENT PREVENTION & RESPONSE

PSYCHOLOGICAL ASPECTS OF EMERGENCIES

LEGAL ASPECTS OF FIRST AID

FIRST AID

"CONFLICTS IN FIRST AID "
PANEL DISCUSSION
All speakers and audience

PRINCIPLES AND PRACTICE OF FIRST AID

Introduction

When a serious accident occurs in the mountains, the first aid that must be performed involves more than simply securing a bandage in place. It involves a complex series of almost simultaneous actions that must be taken correctly and completely if the victim is to survive. The party must concern itself not only with providing urgently needed first aid but with total victim care--physically to include consideration for evacuation, shelter, food, and warmth, and mentally to include alleviating anxiety, worry, and fear. The party must concern themselves too with the remainder of the party, their physical and mental condition. If the party is not kept busy taking care of the needs of the accident victim, and if they do not consider their own needs, they may end up to be a hinderance in subsequent rescue operations rather than of assistance. Each member, therefore must know exactly what to do and how it should be done. That is why it is the responsibility of all who venture into the mountains to possess a working knowledge of how to properly respond to an accident and to perform essential first aid.

How does one acquire this knowledge, and what must the party do specifically to aid the victim? To the first question, --how to acquire the knowledge--one must learn under controlled conditions the necessary skills and PRACTICE those skills (just like driving a car). Throughout the United States there are a number of courses of recognized merit that teach first aid and emergency care. In some communities the American Red Cross offers a mountaineering oriented first aid and accident response course which provides the student ACTUAL PRACTICE EXPERIENCE at solving a number of simulated mountaineering accident problems. Such a course provides the student with the instruction and skills necessary to immediately and correctly respond to nearly any mountaineering accident situation...

To the second question, --What does the party do? --this is the subject of this lecture. It will provide a general overview in the following areas:

1. Causes of Accidents
2. Preparing for an Accident
3. General Directions for Accident Response
4. Victim Examination
5. A First Aid Kit
6. Evacuation by a Small Party

CAUSES OF AN ACCIDENT

Statistics indicate that although most accidents involve people with little or no mountaineering experience, those who are often in the mountains will sooner or later become involved. Few accidents involve equipment that has failed or "Acts of God", but rather, 90% of the cases, are caused by negligence, lack of technical knowledge, not applying common sense, or physical or mental fatigue. Knowing this, each of us can insure we are properly prepared and that each party we lead has a proper mix of experienced personnel to beginners.

PREPARING FOR AN ACCIDENT

Preparing to respond to an accident starts at home, before the outing. It involves both mental and physical preparation. Mentally, it involves acquiring knowledge of first aid, rescue operations, survival techniques and climbing techniques like belaying, anchoring, and protecting oneself. It also includes planning the trip to insure the party does not get on hazardous terrain or terrain beyond their ability, that they have selected a competent leader, etc. Physically, preparation involves physical conditioning and equipment. It is this last point, equipment, that is most frequently a problem and, therefore, is discussed further.

Since one cannot predict when an accident will occur, it's vitally important to carry enough for any emergency situation under the worst possible conditions for that time of year. If it's summer, carry raingear even though the chance of rain is small. If it's winter, carry a tent. Always carry in excess to your own needs, to be able to provide something to the accident victim since he may not be as well equipped as yourself. In short, carry the "Mountaineering Ten Essentials":

Knife	Extra Food
Map	Extra Clothing
Compass	Flashlight
Matches	Sunglasses
Firestarter	First Aid Kit

In addition to these, however, carry what I choose to call, the "Ten Essentials of Accident Response". In total they weigh less than two pounds and include:

.Ground Insulation--If each member of the party carries a small piece of Ensolite, the victim can be adequately insulated from snow or rock.

.Tube Shelter--Tarps blow away. Plastic tube shelters can keep you dry.

.Saw--It is difficult to cut two inch slide alder with a pocket knife. Equipment is needed for cutting firewood, for constructing a branch stretcher, for cutting ice blocks, etc.

.Twine--For a variety of uses.

.First Aid and Rescue Directions--But don't read over the victim.

.Wire Splint--For splinting when other materials are not available. An ice ax, for example, cannot be used for splinting a forearm fracture.

.Thermometer--For determining the temperature of water in treating frostbit and taking the victim's temperature otherwise.

.Smoke Flare--For signalling.

.Marking Tape--Used when going for help.

Accident Form and Pencil.

These items cannot be improvized. Their presence is essential for response to an accident to be effective.

Preparation does not end at home but continues at the trailhead. The leader for example ensures that extra equipment is taken for use by the party in an emergency. Additionally, he makes it a point of knowing members capabilities, and choosing an assistant leader and rope leaders that can handle themselves in all situations. He discusses what to do if an accident occurs and verbally prepares the party for that eventuality.

GENERAL DIRECTIONS FOR ACCIDENT RESPONSE

If an accident does occur, there are seven general directions for response that MUST be followed correctly and completely. They are:

1. TAKE CHARGE--Someone must take charge of the situation and direct the activities of the party. If the leader is injured, the assistant leader takes over.

2. APPROACH THE VICTIM SAFELY--Protect him from further harm by choosing a safe route to approach. Pool the party equipment and send the most qualified members to help.

3. PERFORM URGENTLY NEEDED FIRST AID AND EMERGENCY RESCUE--If the victim is on the edge of a cliff, secure him and yourself. Then check breathing, circulation and bleeding.

4. TREAT FOR SHOCK--Keep the individual lying down. Maintain body heat. Add fluids and provide "Tender Loving Care" (TLC).

TLC is extremely important. Nearly all injured people want to know what their injuries are (approximately), how serious it is, who is there to aid and what the first aider intends to do. In short, they want someone to talk to. This benefits the first aider too, in determining where it hurts, how it happened, etc. Talking alleviates anxiety on everyone's part and is an essential part of proper care.

5. CHECK FOR OTHER INJURIES--Perform a thorough examination starting at the head and working down.

6. PLAN WHAT TO DO--Consider:

   - Method of Transport--Walk, Carry, Helicopter?
   - Summon outside help?
   - Terrain, Time of day, Distance?
   - Weather and season of year?
   - Injuries?

7. CARRY OUT PLAN--Do the following:

   - Gather data and fill out an Accident Report Form
   - Send for help.
   - Prepare shelters, food, drink.
   - Build fire.

- Perform First Aid.
- Prepare stretcher.
- Prepare for belaying and lowering.
- Mark and clear trails.
- Inventory supplies.
- Send other party members OUT.

In summary, be prepared for any situation. Think and act in terms of what you can do for the victim. Treat him as if his problems were your own.

VICTIM EXAMINATION

The importance of a comprehensive and timely victim examination cannot be over-emphasized. It synthesizes all previous training the first aider has had. Victim exam is where the signs and symptoms of a variety of injuries are sorted, and from those a diagnosis made of possible problems.

If not done adequately, victim exam cannot help the victim. It can, in fact, cause additional harm if the job is done inadequately.

What are the factors involved in victim exam.

- Signs and Symptoms
- Questions of Circumstances
- A Comparision (with normal)
- Determination of Possible Causes--External, internal, temporary or injury associated.

Let's discuss each of these starting with signs and symptoms of injury. First, victim exam, when major injuries are present a rapid examination, first determine if the victim is breathing, has a pulse and is not bleeding arterially. If there is no problem there, continue to the point of obvious injury as either directly observed or called to your attention by the victim.

Next, perform a comprehensive examination, preferably using a top down approach. For example, for a suspected head injury, examine:

- Hair for bumps, depressions, soft spots, blood, bone fragments.
- Ears and nose for cerebrospinal fluid.
- Mouth inside and out for bleeding, broken teeth, and fractures.
- Facial expressions for a paralysis of one side or the other.
- Eyes to identify if the pupils are dilated, constricted, equal in size, responsive, synchronized.
- Ability to reason, remember and think clearly.

Continue in the same comprehensive manner down the body until thoroughly convinced that all injuries have been located and their extent known.

Another aspect of victim examination is a determination of the problem by inference--that is, by asking the victim, bystanders and yourself--key questions of circumstance that provide a clue as to possible problems. Such questions of circumstance include:

- Where is the injury?
- Did weather or external conditions contribute?
- Anything taken internally?
- Under medication or doctor's care?
- When did individual eat or drink?
- Has problem occurred before?
- Acted unusual before collapsing?

Next, one must compare the signs and symptoms of the victim with a normal person and reflect on the possible causes of those differences. Such causes can be divided into four categories:

- EXTERNAL--such as lightning, excess heat or cold, or lack of oxygen causing electrical shock, heat exhaustion, hypothermia, pulmonary edema or mountain sickness, respectively.

- INTERNAL DISORDERS--such as heart attack or apoplexy.

- TEMPORARY CONDITIONS--such as fainting or physical exhaustion.

- INJURY--such as head injury, wounds, fractures, and others.

All of these clues, then, must be integrated together to identify the possible problem and perform the necessary first aid.

Let's consider an example:

Ahead of you on the trail a person collapses. Their friend yells for help. You start to piece the story together as you hurry nearer.

It is a very hot day. Popular low land trail to small lake. Person who has collapsed looks to be a middle-aged woman and, looking at the clothing, knows little about the out doors. As you approach her friend, she says the victim said, "She felt faint" and collapsed. The victim is breathing and appears uninjured. She regains consciousness in a few minutes and claims she feels fine. Her vital signs are normal. She does not know why she lost consciousness. She is not under a doctor's care, is not taking medicines, claims to be perfectly healthy but has had virtually no water and salt, and little food all day. She admits not being in shape. What is her problem? Answer: A simple case of heat or physical exhaustion or fainting. This is an example of taking all the portions of victim exam together and diagnosing the possible problem. The important point is, we reacted by:

- Asking questions.
- Examining victim.
- Deducing the answer.
- Checking to see if it fits even though this is a single case, the technique of victim exam is valid and it is extremely important that it be done properly and thoroughly.

Victim examination and the resultant treatment is sometimes, however, extremely complicated. If an entire rope team, for example, is involved in a fall resulting in multiple internal and external injuries, the first aider must employ a procedure known as triage--the sorting of accident victims according to the severity of their injuries. If not performed, victims with minor injuries may be treated before those with life-threatening

problems. A situation the first aider must avoid is, to provide care to the one who yells the loudest at the expense of the victim who is quietly bleeding to death. Injuries are normally divided into three categories:

High Priority Injuries---

- Airway and breathing difficulties
- Cardiac Arrest
- Uncontrolled bleeding
- Severe head injuries
- Penetrating chest injuries and Abdominal wounds
- Severe medical problems

Second Priority Injuries---

Lowest Priority Injuries---

- Minor fractures and wounds
- Obviously dead

A SMALL PARTY FIRST AID KIT

What is adequate? What size and shape should a kit be? These questions are difficult to answer, but some generalizations can be made. First, there is no one best kit. A "Best" depends upon the specific needs of the group or individual, the outing duration, the first aid training of those using the kit, the type of injury expected and probability of its occurrence. A kit must be tailored for a specific application. Individual kits, for example, for short one or two day outings, usable by a small party, should have the following components:

1. Bulk dressings for absorbing large quantities of blood.
2. Cravats to hold splints in place (elastic bandages are not acceptable.)
3. A waterproof container or individually waterproofed items.
4. Salt, bandaids, safety pins, soap and other items frequently used outside of the kit in a handy location.
5. Accident report forms, rescue directions and a pencil.
6. Money for phone calls.

Note that drugs were not included in the above list. Not only is it illegal for a first aider to administer a drug, but it can be extremely hazardous depending upon the victim's condition. So what can be done? The first aider may assist an individual in taking prescription medicine at the individual's request. Consequently, at least for pain and known allergies/illnesses, there is something that each of us can do for ourselves--get something for our own consumption that someone can aid us in taking if the need arises.

There are a number of kits on the market, none of which I feel are adequate. Nearly every outdoor publication identifies the contents of a "recommended" kit. This, it appears, only serves to perpetuate the confusion as to what is adequate and what is not. One kit, however, appears to have emerged as being "extremely adequate" and has the approval of the Mountain

Everyone travelling into the mountains or other remote areas of the State should always carry a Minimum of first aid supplies. Without them, should an accident occur, the person assisting will find it impossible to provide reasonable first aid care. One cannot adequately improvise with "nothing but the shirt off your back," when a true emergency exists, you must have the proper equipment and MOST IMPORTANTLY, must know how to use it.

The type of container used to carry first aid supplies does not matter other than it should be compact, sturdy and waterproof. A polyethylene box with tight lid is adequate. A metal box, which can be used in an emergency to melt snow or warm water, is better. The lid is a good place to tape some change for an emergency phone call. Sometimes, some prefer to divide their kit: one portion sealed for true emergencies and the other containing items frequently used such as bandaids, salt, aspirin, molefoam, tape and scissors.

For the past several years the Safety & First Aid Committees of The Mountaineers have been promoting safety in mountaineering activities - whether hiking, fishing, hunting, camping, skiing or climbing. This is being done primarily through informational handouts, such as this, and through free public courses of instruction in Accident Response & First Aid. It is hoped that by teaching how to prepare for a mountaineering accident before it occurs, by teaching the actions neccessary to properly respond should an accident occur and by describing the potential for further injury caused by improper care, the outdoorsman will become more aware of the hazards around him. He will actually PREVENT ACCIDENTS by making mature judgements that reflect his party's strengths and limitations.

If you are interested in participating in a mountaineering-oriented accident response course, contact your local American Red Cross Chapter. If you are interested in reading further about accident response, consult "Mountaineering First Aid" by Dick Mitchell available through The Mountaineers, P.O. Box 122, Seattle, Washington 98111. If you are interested in purchasing the first aid kit described herein, write 602 S. 210, Seattle, Washington 98148.

This brochure has been prepared by The Mountaineers and the Washington State Department of Emergency Services.

An Adequate FIRST AID KIT

is a MUST for ALL outdoor travellers

The Mountaineering First Aid Kit

Item	*Quantity and Size*	*Use*
Accident Form and Pencil	Two	To ensure accurate information is communicated to rescue assistance.
Aspirin	Twelve tablets - 5 grain	1 to 2 every 4 hours, for pain.
Antacid	Six tablets	For indigestion or heartburn; may be Bucladin, Ulcetral, Rollaids, etc.
Antihistamine	Six tablets	1 every 4 hours for insect bites, colds or hives; may be Contact, Coryban D, etc.
Bandaids	Twelve one inch	For minor cuts.
Butterfly Bandaids (or know how make them)	Six (various sizes)	For closing lacerations.
Carlisle Battle Dressing or equivalent bulk absorbant	One 4"x7"	For large bleeding wounds it is absolutely essential that clean absorbant dressings be applied completely over the wound with sufficient pressure to stop bleeding.
Molefoam	½ pkg.	For padding blisters.
Needle	One medium size	To remove splinters, puncturing blisters, etc.
Tincture of Benzoin	1 oz. bottle	To hold tape in place and protect the skin.
Antibacterial soap or Tincture of Zepherin	1 oz. bottle (plastic,	Mild antiseptic for abrasions, cuts.
Razor blade or small scissors		For cutting tape, molefoam, hair, loose bandage ends, etc.
Roller Gauze	Two rolls 2"x5yds.	For holding gauze flats in place.
Safety pins	Three (1 large)	Mending seatless pants.
Salt tablets	Twenty-four	To prevent exhaustion and cramps due to heavy perspiring.
Steri-pad gauze flats	Six 4"x4"	For large abrasions.
Tape, non waterproof	2" roll	For sprains, securing dressings, etc.
Triangular Bandage	One	For supporting arm and protecting dressing from contamination.
Optional Items:		
First Aid and Rescue Instructions		To ensure treatment is complete and correct.
Wire splint	One	For splinting suspected forearm, wrist or ankle fractures.
Thermometer (Oral/Rectal Combination)	One	For determining temperature of victim, or water when treating frostbite.
Tweezers	One pair	For removing splinters.
Perscription Medicines		For pain, sleep, insect bites, etc. To be used only by the person for which it was prescribed. If carried, each should be stored in its original container, clearly labelled as to doseage, purchase date, type of drug and

Rescue Council-Seattle and The Mountaineers. A handout is available for ready reference for those who desire it--as well as a number of other handouts dealing with the general topic of outdoor safety that are distributed by The State of Washington, Department of Emergency Services. It is hoped that by disseminating such information, the overall quality of commercial products and safety associated with outdoor recreation will improve for the benefit of everyone.

EVACUATION BY A SMALL PARTY

Although it is true that the victim of an accident should be evacuated as soon as possible, such evacuation, in some cases may be harmful. Let me explain. The victim's condition should never be compromised. Since he normally will benefit from a period of rest following the injury, no transportation should be considered until his condition has stabilized. ONLY UNDER LIFE-THREATENING CONDITIONS SHOULD EVACUATION BE IMMEDIATE. Those conditions are: If the victim exhibits symptoms of a major head injury, has pulmonary edema, has prolonged unconsciousness or if weather is life-threatening. On the other hand, EVACUATION SHOULD BE DELAYED if the victim exhibits symptoms of apoplexy, heart attack, internal injuries, neck or spinal fracture or skull fracture. A victim may be evacuated routinely by a small party if (and only if) he has NOT sustained major injury and his condition is strong and stable AND if the distance to the road by trail is less than three to five miles. Otherwise, do not subject the victim to the strain of a small party evacuation--await outside assistance.

Sometimes it is better to evacuate other members of the party before they become victims themselves. Before you do:

1. Provide to the needs of the victim first.
2. Leave the stronger and better equipped members behind with the victim with extra food and clothing.
3. Send the others out under competent leadership.

If it is decided to evacuate the victim, prepare him.... Tell him what is going to happen and how he will be moved. Practice on someone else first. Use extreme care with the victim to give him confidence in your ability to move him. Nothing is more embarrassing than to have him leap off the stretcher and declare he would rather walk..... During his evacuation, constantly care for him and monitor his condition. Stop and rest occasionally.

There are a number of techniques that can be used:

1. Backcarry---Either two inch webbing or a coiled rope can be used. Both work but the method is limited to the physical size and strength of the rescuer, and the injuries of the victim.
2. Rope stretcher---The technique of constructing a stretcher from a 150 foot rope is shown here. From the center make 16--180 degree bends, 8 on a side. Come back with the end and tie clove hitches. Insert the bends and snug-up the knots. Pad the stretcher well.

3. Branch Stretcher---A branch stretcher is obviously more rigid and comfortable for the victim than a rope stretcher. A very basic design is shown here. To construct it, one needs 80 feet of 1/8" non-stretch cotton or hemp twine. Corner knots require about 8 feet of twine. Cross bars, spaced about 8 inches apart, require about 2 feet.

4. The Helicopter---has revolutionized mountain rescue. It is quick, efficient, and generally readily available. A small party should be aware of and do several things: First, choose the landing site. A flat-topped ridge is best that gives a 360 degree approach. If a ridge isn't practical, the flat area on a hillside is the next choice where a "drop-off" is possible rather than a "climb-up" during take-offs. Next, remove all obstacles within at least 75 feet and level the landing area if possible. SECURELY ANCHOR ALL OBJECTS. Rotor wash can approach 60 to 120 miles per hour. Next, mark the area with smoke or ribbons. Fourth, transport the victim to the landing zone by using any one of the techniques just discussed. Finally, and most importantly, FOLLOW BASIC RULES OF HELICOPTER SAFETY.

- Ground lowered objects.
- Know hand signals.
- Keep away from landing area and out of flight path.
- Do not approach until the pilot signals.
- Approach the front and low side only.
- Keep your head down.
- Wear protective gear.
- Protect the victim. Do not leave him unattended.

CLOSING REMARKS

In conclusion, an accident scene is an extremely confusing place. It is very difficult to sort through the things that must be done and then to accomplish them in proper order. Like rock climbing or skiing, it takes practice to become proficient. Without some minimal mental and physical preparation before an accident occurs, you are bound to commit errors that could be fatal. Preparation begins at home by taking courses of instruction, practicing proper techniques and carrying the necessary equipment. Effective accident response is a vital skill that must be acquired by everyone who goes into the outdoors. It is easy. It just takes concern, interest and common sense.

LEGAL ASPECTS OF MOUNTAINEERING FIRST AID

BY
Michael R. Green
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Climbing accidents in which death or serious injury occurs are becoming increasingly more common as Americans in greater numbers each year set out to scale mountains with friends, professional guides and club groups. Some climbers have first aid training and some do not, but most would unhesitatingly give whatever first aid they could to a person injured in the mountains without any thought of the legal consequences of their action. However, a decision to render first aid involves certain legal risks that should be recognized.

FIRST AID DEFINED

First aid is the immediate and temporary care given to the victim of an accident or sudden illness until the services of a physician can be obtained. It may be as minor as taping a sprained ankle, or as serious as administering closed heart cardiac massage to an unconscious climber who has been struck by lightning. In any event, the purpose of first aid is to keep an injured person alive and reasonably comfortable until medical help arrives or the victim is evacuated from the mountains.

FIRST AID AND THE UNLAWFUL PRACTICE OF MEDICINE

Persons who may be called on to provide first aid in the case of a mountaineering accident should be aware of the boundary between permissible first aid and the unlawful practice of medicine. All states have laws limiting the practice of medicine to licensed physicians. These laws generally provide that a person is practicing medicine when he (1) undertakes to diagnose or cure any disease or injury, (2) administers drugs or medicinal preparations, or (3) severs or penetrates the tissues of human beings. Some states, such as Washington, have enacted laws that expressly provide that emergency medical care is not the unlawful practice of medicine. The Washington law is limited to furnishing medical assistance in cases of emergency requiring immediate attention. Under this law a person may be acting unlawfully if he attempts to treat an injury that does not require immediate attention. Under this law a person may be acting unlawfully if he attempts to treat an injury that does not require immediate attention. A person administering first aid should therefore limit his assistance to injuries requiring immediate attention and should avoid administering drugs, setting fractures and performing other medical acts unless absolutely necessary to save the injured person's life or to protect him from serious harm.

NO DUTY TO GIVE FIRST AID

Mountain climbers, like anyone else, are ordinarily under no legal duty to give first aid to an injured person. There are exceptions to this rule. A professional climbing guide or a mountaineering club sponsoring a climb may have a legal duty to give first aid to an injured climber in the party. The law may also impose a duty on a climber to render aid to another person if he has negligently caused the injury. Except for special situations like these the law imposes no duty on a person to give aid to a person in the mountains regardless of how easy it would be to help or how dire the consequences of not doing so would be.

LAW OF CONSENT

The intentional touching of another person without authorization is a legal wrong called battery for which an individual can be sued. Every person has a legal duty not to touch another individual unless the touching is authorized, and every person has the right to refuse to allow anyone to touch his body. Since first aid involves touching the injured person's body, it must be authorized or the person giving aid may be subject to a lawsuit for battery.

CONSCIOUS ADULT VICTIM

If an accident victim in the mountains is conscious and is an adult, he may expressly authorize first aid treatment or he may voluntarily submit to first aid without making any objections. In either event the person giving him first aid will not be liable for battery. But an injured person may also be uncooperative and refuse to allow anyone to touch him. The law recognizes the right of every individual to govern his own destiny, even if he will die without medical treatment; and if an accident victim says "don't touch me" a person administering first aid over his protests may be subject to a suit for battery.

MINOR VICTIM

If the injured person is a minor it is necessary to consider whether his consent is valid. The age when a person becomes an adult varies from state to state. In some states the age is twenty-one, and in other states such as Washington it is eighteen. As a general rule, the consent of a minor to medical treatment is ineffective and his parents' consent must be obtained or the person giving medical aid will risk liability to the minor or to his parents in a suit for battery. In mountaineering accidents a minor's parents may not be conveniently nearby to give their consent. In that event it would probably be sufficient to obtain the minor's authorization for first aid if immediate treatment was necessary in order to keep him alive or to prevent him from suffering serious injury.

UNCONSCIOUS VICTIM

The unconsciousness of an accident victim would make it impossible to obtain his consent to first aid. In that event a person would be legally justified in giving first aid to the victim if immediate treatment was necessary to keep him alive or to prevent serious harm. Such a situation is considered an emergency, which does away with the need for consent. A person might also be conscious but dazed and irrational after an accident. In that situation consent should not be required if immediate treatment is necessary to save his life or to prevent serious injury; and a first aider would probably be legally justified in giving first aid even if the injured person said he wanted no one to touch him.

NEGLIGENTLY ADMINISTERED FIRST AID

If an individual gives first aid to an injured person he is under a legal duty to act as a reasonably prudent person would under the circumstances, and if his actions injure the other person, he may be liable in a suit for negligence. In an accident situation it would be reasonable for a person to give the kind of first aid he has been trained in and to limit his assistance to that necessary to keep the victim alive and reasonably comfortable until competent medical care can be obtained. It may not be reasonable to go beyond that point. For example, if a person who only has first aid training attempts to set a shoulder dislocation, or administers drugs to combat infection when medical care is only an hour or so away from the accident scene, there is a substantial risk that a court might find such action to be unreasonable.

The reasonableness of the skill exercised in rendering first aid will vary with the training of the individual. A person with limited first aid training might splint an arm poorly and not be liable for negligence, while a physician would be required to exercise a much higher level of skill in applying a splint because of his medical training.

The accident situation will also influence the reasonableness of a course of action. Normally, an untrained person should not administer first aid. Yet if his climbing companion has no heartbeat after being struck by lightning it may be reasonable for him to attempt closed chest heart massage in order to save his friend's life. Similarly, it may be reasonable under the circumstances for a physician to perform an emergency tracheotomy with a pocket knife if necessary in order to save an injured climber's life, or for a climbing party to move a climber with a broken back out of the way of falling rock.

In the abstract it is difficult to determine whether situations such as these would result in liability for negligence or not. Each case would be decided on its own facts; and in assessing the reasonableness of the action taken, a judge or jury would probably give considerable weight to the hazards inherent in mountaineering and the reliance that society must place on individuals with limited medical training to save lives in the wilderness.

GOOD SAMARITAN PROTECTION

Some states have expressly recognized the importance of protecting individuals who come to the aid of another person by enacting "Good Samaritan" statutes. Some of these laws only protect physicians, but some states apply them to all persons. They generally provide that persons who render emergency medical care at the scene of an accident will not be liable for the result of their actions unless they are grossly negligent or their actions amount to willful or wanton misconduct. The state of Washington has a Good Samaritan law which provides that:

> Any person who in good faith and not for compensation renders emergency care at the scene of an emergency or who participates in transporting, not for compensation, therefrom an injured person or persons for emergency medical treatment shall not be liable for civil damages resulting from any act or omission in the rendering of such emergency care or in transporting such persons, other than acts or omissions constituting gross negligence or willful or wanton misconduct.

In states that have adopted Good Samaritan laws as broad as Washington's, persons giving first aid assistance to an injured mountaineer will be insulated from liability even if they do not do what a reasonably prudent person would do under the circumstances. Only where their action is highly unreasonable and rises to the level of gross negligence or willful or wanton misconduct will the law impose liability on them.

FIRST AID CARE IN CLUB SPONSORED AND COMMERCIALLY GUIDED CLIMBS

Individuals who climb together as friends can expect the law to be charitable toward their efforts to aid injured companions or strangers in the mountains. It is doubtful that a court would impose a legal duty on them to have first aid training and the reasonableness of their response to an accident would probably be governed by whatever training they may have. The situation is different for commercially guided climbs and climbs sponsored by clubs. In those situations the law may impose a legal duty on the club or the commercial guides to have a person along on the climb who is adequately trained and prepared for accidents and to administer effective first aid care if an accident occurs.

METHODS OF AVOIDING LIABILITY FOR FIRST AID

How can mountaineers protect themselves from lawsuits arising out of first aid given to an injured person in the mountains? Clubs and commercial guides may obtain insurance to protect them from liability arising from climbing accidents. It is also possible that individuals may be able to obtain insurance protection through their homeowner's insurance policies.

Clubs and commercial guides may also require climbers to sign release forms relieving a club or a guide from all liability for injury that might occur while climbing with the club or the guide. Release forms such as these may be valid in some states but not in others. In the state of Washington a court has recently held that a release was valid in a lawsuit against a scuba diving school by the heirs of a student who failed to surface during one of the school's dives. The validity of a release in a mountaineering accident does not appear to have been considered by any court. However, the reasons supporting the validity of a release in the context of scuba diving would also appear to apply equally to mountain climbing.

Perhaps the most important means of providing protection against lawsuits is through education. Climbers should insist that the persons they climb with, whether as friends, professional guides or in clubs, are adequately equipped and trained. But regardless of the care that climbers exercise the forces of nature cannot always be avoided and accidents will inevitably happen in the mountains. The response of climbers to such accidents can still prevent legal exposure if they are reasonably careful because the law recognizes the essential role of the Good Samaritan, and the basically risky nature of the mountaineering experience.

Cardiovascular Adjustments of Physical Conditioning

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MOUNTAIN MEDICINE SYMPOSIUM

SECOND DAY PROGRAM

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MOUNTAIN MISERIES

FROSTBITE

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FIRST AID KITS & DRUGS

GROUP DISCUSSIONS ON
- First and Second Aid
- First Aid Kits
- Frostbite and Hypothermia
- Physical Conditioning
- Legal Aspects

MEDICAL ASPECTS
(Physicians only)

EXPEDITION TRAVEL AND YOUR HEALTH

By

Dr. Peter Steele

The unprepared and the unwary are those for whom expeditions abroad can end in misery and expense ('when a party becomes labelled an expedition it means there are a lot too many people'--Tilman). Not only may the sick member fall by the wayside but the entire trip may be put in jeopardy involving huge wastage of money, time and opportunity. Illness can often be avoided by adequate preparation beforehand and common sense precautions during the journey. In this chapter I am not trying to offer you a complete medical compendium, rather a guide to preventing the common hazards of travelling abroad, with reference to the main problems of widely differing geographical situations.

It is always comforting to have a doctor along but do not be lulled into false security. A doctor is of use only in proportion to what he knows and understands about the medical problems of the highly specialized environment in which you are travelling. Just because he has MB, or whatever, after his name does not mean he is any more use than a competent traveller who has bothered to learn the elements of the trade as it concerns a sick man in wild places.

Fitness

I am not a physical training fiend since, by having the good fortune to be of lean build and by taking a moderate amount of exercise, I keep a steady level of fitness. I can see little point in training madly before an expedition unless you are grossly out of shape (if you are in such a state you probably will not be invited anyway); one attack of diarrhoea will reduce athletic muscles to jelly in a few hours. However you should see that you are in reasonable health, and the exercise that will be an inescapable part of your journey will fix the rest.

MEDICAL PRELIMINARIES

Before embarking on an expedition you would be wise to have a thorough medical check-up and certain tests, not only to see that you are fit, but also to have a baseline for comparison should you fall ill later. You do not have to be tough and hairy to go on an expedition or be a good outdoorsman--some of the greatest explorers were written off as weaklings in their youth. Leaders should beware of excluding good men because of doubtful medical records that may be no longer relevant. The examination should include:

1. Past Medical History

   Serious illnesses, operations (particularly appendicectomy) and drug sensitivity or contact allergy.
   Personal medical details can be imprinted on a bracelet or medallion that must be worn constantly (Medic-Alert).

This is safer than a card carried in the pocket or wallet, and may be life-saving in an emergency.

e.g. Blood group - in case blood transfusion is needed after an accident.
Drug treatment dosage - for diabetics, epileptics and those taking steroids or other medicines.
Sensitivity - to specific drugs, e.g. penicillin, sulphonamides, aspirin.
Allergies - to bites, stings and pollens.

2. General Physical Examination

Together with these tests; urine analysis, hemoglobin and blood group, chest x-ray, and T.B. tests.

3. Dental Check

Remember to take with you:

Medicines with which you are already being treated. The dosage and pharmocological name should be written on the bottle since proprietary names vary in different countries.
Spare spectacles and your lens prescription.

In many countries long hair is synonymous with "hippies" and undeserved rough handling may be given by the police and government officials. Apart from which long hair is difficult to keep clean.
VD is never caught off cracked cups or lavatory seats but it is sometimes carried unknowingly, particularly by women. Local "groupies" "who provide creature comforts that are lacking during an expedition" have introduced new hazards. Any man who, having put himself at risk, has a discharge from the penis and passes water painfully and often should go for an immediate check-up and warn his girlfriend to do likewise.

INSURANCE

Falling ill abroad can be very expensive. The cost of consultation, medicines, treatment and hospital care must be paid for by the patient. As this could be financially crippling, full health insurance is a wise precaution. You should consult a reputable company for advice on the policies available.

Insurance covers the cost of medical treatment abroad or of flying the sick person home--this may be safest and cheapest in the long run.

Don't forget to insure every member of the party.

If you incur medical expenses, present your policy to the doctor and ask him to send the bill direct to your insurance company if you pay cash, keep a receipt which will be honored on your return.

If you are going to take part in "high-risk sports" you will need a more specific insurance cover. You should consult a company who specialise in this field and will give you an individual quote.

IMMUNIZATION

Immunization can protect you from certain infectious diseases that are common in countries abroad but rare at home. Your local public health department will advise you on the innoculations necessary for a particular country you may wish to visit and how to obtain them, either at a clinic or through your family doctor. Do not leave it to the last moment as a full course can take up to three months to complete properly.

Immunization is not obligatory in Europe or North America, but it is wise to be protected against: --

1. Typhoid, Paratyphoid A & B and Tetanus (TABT). Two injections are given one month apart. An unpleasant reaction, with a sore arm and headache is not uncommon and you must avoid alcohol for 24 hours. After a wound from a dirty object or an animal bite you should obtain a booster dose of Tetanus Toxoid.

2. Smallpox, Yellow Fever and Cholera. Although not obligatory for Europe, it is wise to keep up to date. Smallpox immunization is compulsory for Asia, Australia and parts of Africa; Yellow Fever for Central and South America and Central Africa. A valid International Certificate must be carried. Smallpox immunity lasts three years and Yellow Fever ten years.

   Cholera immunization may partly protect the individual for a short period but its value in international control of the disease is in doubt.

3. Diphtheria, Poliomyelitis and Tuberculosis (B.C.G.). Immunization is given to most children and lasts, so usually need not be repeated.

   Three months should be allowed for a full course of immunization, but in emergency a "crash course" of Smallpox, TABT, Yellow Fever (and Cholera) can be given in 15 days.

4. Malaria is not a danger in Europe, North America and the near East; but if you visit a malarial zone elsewhere in the world, a course of prophylactic anti-malarial drugs should be prescribed by your doctor starting one week before departure and continuing for at least a month after return.

   Human Gamma Globulin has gained the reputation as a universal protector, especially against infective hepatitis (jaundice). Passive immunity lasts only a few weeks and its effectiveness is not 100%.

TRAVELLER'S DIARRHOEA

Gippy Tummy, Delhi Belly, Kathmandu Quickstep - it has as many names as patent remedies and strikes most travellers at some stage in their journey making more trouble than all the other illnesses mentioned here, put together. The causes are usually untraceable but may include gluttony, change in climate and an upset in the bacteria that are normal and necessary in the bowel. Infection with disease-causing organisms carried in water and food is less common.

Much of the pleasure of travelling abroad comes from eating local food and drinking wine; it is hardly worth going all that way for beer, fish and chips. Be moderate to prevent the tummy upset that will spoil your holiday, and even make you into a useless member of the party.

Precautions:

(a) Water warrants the utmost care as carelessness may be very costly. In some clean hotels and restaurants the water is safe to drink. Stream and river water is likely to be polluted unless it comes directly from a hillside spring, and glacial mud or mica in alpine rivers is especially irritant to the gut. If you are in doubt drinking water should be sterilized.

- Boiling briskly for a few seconds kills most organisms (including amoeba cysts and infectious hepatitis virus). So drink tea or coffee.
- Water-purifying tablets. Chemical treatment is less effective than boiling, takes longer and leaves a taste of chlorine, but is useful if boiling is not practicable.
- Filters purify water less surely than boiling, but they do get rid of the murky colour of suspended organic matter.

(b) Drinks: Bottled fizz is usually safe. Wine and spirits drunk in moderation are harmless, but mixing them with water has no "sterilizing action".

(c) Food: Freshly and thoroughly cooked food is safe since any bacteria will have been killed by the heat. So avoid pre-cooked and handled foods, especially when flies abound. Peel fruit and vegetables; thorough washing is only second best so beware of salads, lettuces and watercress. Keep to well-advertised brands of ice-cream, and risk shellfish only if you have a tough stomach.

(d) Hygiene: Toilets abroad are often dirty; you may have to squat and keep your balance by holding on to the walls. So wash your hands carefully with soap as soon as possible afterwards. Take your own toilet paper as newsprint is rough and fragile. At campsites dig a latrine hole well away from the tents, and your water supply.

Brush you teeth in clean water only - chewing gum is a useful temporary cleaner.

Treatment of Traveller's Diarrhoea

The illness usually clears up on its own in 2-3 days. You may also vomit and because a lot of body water is lost you may feel groggy. Go to bed and drink unlimited fluids (at least a pint an hour). Avoid eating - except dried toast and peeled grated apple gone brown (pectin). A binding medicine will speed recovery. A dose of the "Everest Blunderbuss Cocktail" constipates most people for a week: Kaolin powder 2 tablespoons, Tincture of morphine (chlorodyne) 4-6 drops, Codeine phosphate 30 mg., and "Lomotil" 4-6 tabs. or any of these singly if all are not available. Antibiotics, though fashionable, should not be used blindly since they kill normal bacteria, which are protective, as well as poison-producing ones.

Dysentery

If diarrhoea does not stop within 24 hours on this treatment, or if blood appears in the stools, a doctor should be consulted since you may be suffering from dysentery, if you cannot find help the best drug to start with is Co-trimoxazole. Bacillary Dysentery starts suddenly with acute diarrhoea, fever and malaise. Amoebic Dysentery causes slimy mucus and blood and warrants laboratory investigation and treatment. Its severity builds up slowly over several days.

Worms

...are common in tropical countries. They cause an itchy bottom and can often be seen in the stools. Take 1 Piperazine sachet.

Indigestion

Magnesium Trisilicate gets rid of wind and may even help a hangover.

Constipation

Drink plenty and eat fruit; if this fails take two laxative tablets.

N.B. Beware the person who feels sick, has no appetite, a dirty, coated tongue and pain in the belly. If the abdomen is tender, particularly in the right lower quarter, you should suspect appendicitis and visit a doctor.

Waterworks

Infection is more common in women. It begins as frequent passing of urine with burning pain. Drink a pint of water hourly with a tablespoon of bicarbonate of soda and take an antibiotic if it does not improve in a day.

INFECTION

General infections

Antibiotics must not be eaten indiscriminately but if you develop an infection with a high fever and rapid pulse when you are away in the wilds on your own, blind therapy with a broad spectrum bug-killing drug may be justified. Co-trimoxazole or Amoxycillin should be taken for a full five day course.

Local infections

Eyes: If the eyes are pink and feel gritty wear dark glasses and put in antibiotic ointment. A few drops of Amethocaine will anaesthetise the cornea to let you dig out a foreign body. Homatropine dilates the pupil and relieves painful spasm but will temporarily blur the vision.

Ears: Keep dry with a light plug of cotton wool but don't poke matches in. If there is discharge and pain an antibiotic may be needed.

Sinusitis: Gives a headache (felt worse on stooping), "toothache" in the upper jaw, and often a thick snotty discharge from the nose. Inhale steam with Tinct. Benz. or sniff the tea brew with a towel over your head to help drainage. Decongestant drops may clear the nose if it is mildly bunged up, but true sinusitis may need an antibiotic.

Throat: Cold dry air irritates the throat and makes it sore. Gargle with a couple of Aspirin or table salt dissolved in warm water; or suck antiseptic lozenges.

Teeth: When brushing teeth is difficult, chewing gum is useful. If a filling comes out a plug of cotton wool soaked in oil of cloves eases the pain; gutta percha, softened in boiling water is easily plastered into the hole as a temporary filling. Hot salt mouthwashes encourage pus to discharge from a dental abscess but an antibiotic will be needed.

Feet: ...take a hammering so boots must fit and be comfortable. Climbing boots are rarely necessary on the approach march to a mountain; gym shoes or flip-flops are useful. At the first sign of rubbing put on a plaster.

Blisters: Burst with a sterile blade or needle (boiled for three minutes or held in a flame until red hot). Remove dead skin, spray with Tinct. Benz. (ouch!) and cover the raw area with zinc oxide plaster; leave it in place for several days to allow new skin to form.

Athlete's foot: Wash with soap and dry carefully between the toes; then dust with antifungal powder and wear open sandals.

Muscle ache: Rub Methyle Salicylate (Wintergreen) ointment deeply.

Cramps: Take extra salt in your diet or use salt tablets. Modify exercise until you are fit.

Sun

The sun may be a stealthy enemy. Sunlight reflects strongly off snow and light-coloured rocks; its rays can penetrate hazy cloud and are more powerful the higher you climb. Until you have a good tan protect yourself with clothing and a hat. An ultra-violet barrier cream screens the skin but with excessive sun it merely acts as fat in the frying process. Rationing sunlight is cheaper and more effective.

Sunburn: Calamine soothes shrimp-pink prickly hot skin; if you turn bright lobster and blister you are severely burnt and should obtain a steroid cream.

Sunstroke: If you develop a high temperature and feel ill after being in strong sun, cool yourself with cold water sponging or ice packs, drink ample fluid and take Aspirin to lower your temperature and relieve headache. Collapse from sunstroke warrants urgent medical help.

Snowblindness: is caused by an ultraviolet burn of the cornea, resulting in intense pain and swelling of the eyes. It can be prevented by wearing dark glasses or goggles; horizontal slits cut in a piece of cardboard will do in emergency. Amethocaine drops will ease the pain enough to reach camp. Then put Homatropine drops and antibiotic ointment in the eyes and wear dark glasses or cover with eye-pads and a bandage if the pain is severe.

NATURE'S ANNOYANCES

From flies and mosquitos, bees, wasps, ants and hornets; from fleas, lice and bedbugs; from sea urchins and jellyfish; and from a host of other creepy-crawlies we pray deliverance. Repellant sprays (containing Dimethylphthalate) only last a few hours; DDT may repel a few beasties. If you are unfortunate enough to be attacked the basic problem is itching like mad. If there is a string remove it. Treat the pain and irritation with Calamine cream or lotion, and Promethazine or Chlorpheniramine tablets. Scratching with grubby finger nails may cause the bite to go septic -- so don't.

Arthropods: Lice, fleas and bedbugs are common in huts; DDT helps to keep them at bay.

Mosquitos are usually only a bother at lower altitudes. A net makes sleeping more comfortable but does not guarantee protection from malaria.

Snakes: Clean the area and suck the wound. Do not slash the skin with razor blades or urinate on it. Remember only poisonous snakes cause snakebit poisoning - it is quite rare. Local hospitals probably carry the antiserum against the common local snakes.

Dogs: Bites always warrant an anti-tetanus booster. Rabies is rare but possible.

Leeches are most troublesome during and shortly after the monsoon in the tropics. You do not feel them and may only notice a bootful of blood at the end of the day. Open sandals let you see them early - a lighted cigarette or salt makes the leech drop off, and insect repellant keeps them at bay.

Wasp stings - vinegar. Bee stings - bicarbonate of soda.

Bilharzia is widespread in parts of Africa so avoid tempting cool-offs in slow flowing rivers and lakes where the flukes breed.

Poisoning: Try to make the person sick by drinking a salt solution or sticking the fingers down his throat. Then drink plenty of milk.

INJURY

Nature is a wonderful healer if given adequate encouragement.

Cuts and grazes go septic quickly so must be taken seriously. Wash thoroughly with soap and water or an antiseptic solution (gentian violet or potassium permanganate). Cover with a sterile plaster strip or non-stick gauze. Antiseptic cream may be used if the wound is difficult to clean adequately, but it tends to make the dressing stick and keeps the wound moist, which delays healing. Anchor dressings are useful for awkward places i.e. fingers, heels. If the cut is clean and gaping bring the edges together with "Steristrips" in place of stitches.

Deep Wounds: Firm pressure on a wound dressing will stop most bleeding. If blood seeps through put more dressing on top, secured with absorbent crepe bandage, and keep up the pressure, elevating the part if possible.

Burns when superficial are simply skin wounds. Leave open to the air to form a dry crust under which healing goes on. If this is not possible cover with non-stick dressings. Burn creams offer no magic. Deep burns must be kept scrupulously clean and treated urgently by a doctor. Give drinks freely to replace lost fluid.

Sprains: Apply a firm crepe or elastoplast bandage. If painful movement and swelling persist, suspect a fracture. Cold compresses help reduce swelling.

Fractures: Immobilize the part by splinting to a rigid structure; the arm can be strapped to the chest, both legs can be tied together. Temporary splints can be made from a rolled newspaper, an ice-axe or a branch. Pain may be agonizing and is due to movement of broken bone ends on each other.

PAIN

Pain-killers fall into three strengths for different grades of pain:

Mild - Aspirin (lowers the temperature but can irritate the stomach) Paracetamol is a useful alternative.

Moderate - Pentazocine (can cause hallucinations).

Severe - Pethidine, Morphine (may depress the breathing dangerously. Only available on special prescription).

UNCONSCIOUSNESS

The causes range from drowning to head injury, diabetes to epilepsy. Untrained laymen should only attempt to place the victim in "the draining position" - lying on his side with the head lower than the chest to allow secretions, blood or vomit to drain away from the lungs. Hold the chin forward to prevent the tongue falling back and obstructing the airway. Don't try any fancy manoeuvres unless you are practised, as you may do more harm than good.

Fainting

Lie down and raise the legs to return extra blood to the brain.

SUGGESTED BASIC KIT (for 4-6 persons for 2 months)

NB: Only pharmacological names which are universally accepted are used; trade names are intentionally avoided.

Dressings

1	Plaster Dressing Strip 36"	4	Guaze Squares Plain
4	Anchor Dressings	4	Non-stick 4" x 4"
1	Zinc Oxide Plaster 1" x 5m	2	Paraffin guaze 4" x 4"
1	Elastoplast 3" x 5m	1	Cotton Wool Compressed
1	Steristrip (1/4" x 4")	1	Wound dressing
1	Bandages Crepe 3"		
1	Cotton 2"		
1	Triangular		

Cleaning	1	Soap bar
		Gentian Violet (crystals)
	1	Antibiotic eye ointment
Instruments	1	Scissors blunt/sharp
	1	Forcepts oblique end
	1	Scalpel blade (sterile)
	4	Safety pins
	2	Luggage labels
	1	Marker pencil

Medicines

Pain-killers (mild)	60	Aspirin
(mod)	20	Pentazocine
(severe)	10	Pethidine 50 mg. tab
Antibiotic	40	Co-Trimoxazole
Antihistamine	40	Promethazine 25mg
	20	Chlorpheniramine 4 mg.
Sleeping	20	Diazepam
	100	Water Purifying Tabs
Diarrhoea	1/2 lb.	Kaolin powder
(and cough)	40	Codeine Phosphate 15 mg.
	40	Diphenoxylate
Constipation	10	Senokot
Indigestion	30	Magnesium Trisilicate
Salt	20	Salt Tablets
Vitamins	40	Multivite
	40	Vit. C
Anti-worm	4 sach	Piperazine
Eyes/Ears	1	Neasporin
Eyes	1	Amethocaine drops
	2	Homatropine drops
	2	Fluorescein papers
Nose	1	Decongestant drops
Throat	40	lozenges
		Gentian Violet crystals
Teeth		Oil of cloves
	1	gutta percha temporary filling
Skin		
Sun creams	1	Calamine cream
	1	Methyl Salicylate ointment
	25	Tinct. Benzoin
	1 tin	(anti fungal) powder (25 G)
	10	suppositories, Hemorrhoidal
	1	DDT powder

SUMMARY OF TREATMENT OF THE COLD INJURED PATIENT

William J. Mills, Jr, M.D.

GENERAL HYPOTHERMIA

Confronted with the victim of cold injury, first consideration is a determination of the condition of the patient, as in any emergency. The degree of hypothermia present is of prime concern. General body cooling, and loss of heat, with exhaustion of caloric reserve and severe depression of core temperature may lead to death. Homothermic control is unstable and often lost at temperatures below 94°F. Continued cooling, unrelieved heat loss, may result in coma, and eventually cardiorespiratory failure even before the level of 88°F.

From resuscitation techniques perfected and utilized when general hypothermia is used as an adjunct to surgical anesthesia, we recommend rapid thawing of the patient with warm packs and blankets, or rapid thawing in a warm tub, or the use of warming fluids, or dialysis as mentioned in other parts of this issue of *Alaska Medicine*.

Whatever method chosen, one must understand the problem to obtain the best results. The intravenous infusion of glucose and water, with all respiratory aids including intubation and oxygen if necessary, are utilized, and preparation made for cardiac defibrillation, or intubation, or tracheostomy if necessary. Pre-existing anoxia, generalized, or of local tissues, and trauma with excessive blood loss, as well as alcoholic or drug stupor, may complicate treatment and recovery.

Thawing in a warm water bath, 90° to 106°F., (32 to 37.7° C.) will bring your patient rapidly to a responsive state. The change is dramatic, the patient becoming quickly alert, rational, and vocal. So rapid however, is this method of thawing, that the tissue liberation of acid end products of metabolism and the sudden end result of metabolic acidosis may result in death by ventricular fibrillation in less than one to three hours after this mode of thawing. The result (death) may be the same by delayed thawing (that is by room temperature) without adequate supervision, death then often occurring in 24 to 48 hours.

Initial care, then, is directed to avoiding fluid and electrolyte imbalance and its subsequent changes. Electrolyte monitoring by pH determination, pCO_2, and pO_2 should begin immediately, and should be checked constantly as fluids are given, particularly after the use of sodium bicarbonate or THAM. Electrocardiographic monitoring must be performed. Venous blood is sufficient for pH readings. Due to rapid changes in electrolytes, results should be obtained quickly, for adequate counter action. Occasionally, due to loss of electrolytes from gastric suction, or from the effect of the treatment of a stress ulcer, alkalosis may occur, especially if Naso-gastric suction is used.

If severe frostbite is combined with significant hypothermia, you may wish to treat both conditions simultaneously. This may be done, after adequate monitoring is arranged, by (1) warm water immersion in a tub, or (2) by warm water immersion combined with peritoneal dialysis.

FROSTBITE

Frostbite is true tissue freezing, and occurs when there is sufficient heat loss in the local area to allow ice crystals to form, and extract cellular water.

In order of prognosis, from best to worst, methods of thawing are (1) rapid rewarming in water (100 to 112°F. 37.7 to 44.5°C.), (2) gradual thawing at room temperature (the problem here is the variable room temperature between that of an average heated home to that of a cool cabin in the wilderness) (3) delayed thawing or thawing with ice and snow techniques (4) thawing by excessive heat (120°F. or higher). At present, rapid rewarming is favored, this method seeming to demonstrate the greatest tissue preservation and the most adequate early function especially in deep injury. Results by gradual thawing vary in deep injury, but seem satisfactory in the superficial injury patients. Ice and snow thawing gives variable results; most often poor, with marked loss of tissue. The use of excessive heat as a thawing method has resulted in disaster in most cases, especially with dry heat at temperatures of 150 to 180°F. (66 to 82°C.) (as the use of diesel exhaust, wood fire, stove heat).

Treatment generally can be divided into two categories. *(A) Before Thawing.* Here the *frozen part must be protected to avoid trauma,* should be *thawed in a whirlpool bath or tub water bath* or if nothing else is available, with warm wet packs at *100 to 112°F. (37.7 to 44.5°C.). Temperatures should not exceed 112°F. or 44.5°C. The thawing is completed when the distal tip of the thawed part flushes. Sedatives or analgesics may be utilized* if the thawing process is painful and cannot be tolerated. *The part should not be massaged. Do not use rapid rewarming if the part has previously thawed.*

(B) After Thawing. When injury is severe, and deep, and hospitalization is required, *the extremities are kept on sterile sheets, with cradles over the frostbitten extremity to avoid trauma and pressure.* This is not necessary for upper extremities that may be laid out upon sterile sheets over the chest and trunk. *Treatment is open,* not occlusive, without the use of wet dressings, unguents, ointments, or petrolatum gauze. *Whirlpool baths are utilized twice daily for 20 minutes* at a time, at temperatures between 90 to 95°F. *Surgical soaps such as hexachlorophene or betadine are utilized in the whirlpool.* Occasionally after Moyer's method for burns, *0.5 per cent silver nitrate may be lavaged over the area of frostbite.* The end result is similar to that of the soaps, hexachlorophene and betadine, epithelialization is similar, with one outstanding difference. Pain is less and infection, even superficial, is must less obvious using the silver nitrate solution. *By the use of whirlpool, the debris is cleansed from the part,* and superficial bacteria removed. The tissues are debrided without trauma by the whirlpool action, when they are physiologically prepared to separate viable tissue from the overlying eschar.

Generally blebs are left intact since the contents are sterile, as are the underlying tissues. The blebs are debrided or trimmed only if infected and contain purulent material. *Escharotomy should be performed* on the dorsum or lateral aspect of the digits when the eschar is dry and has firmed sufficiently to have a cast effect on the digits, limiting their joint motion. Digits will be debrided further in the whirlpool without prematurely exposing underlying granulation tissues. *Debridement or amputation should be delayed* until sufficient time (often 30 to 90 days) elapses to demonstrate mummification and tissue death with no danger of further retraction of tissues.

In recent years, the use of felt liners has been popular as a snow boot. Occasionally an extremity (s) immersed in overflow water or wetted by other means, has sustained freezing injury, and the felt liner wet, then freezes and contracts, acting as a tourniquet about the lower extremity. The use of neoprene or rubber "Scuba" type foot cover may cause occlusion of circulation, especially at high altitudes. Freezing, in such cases, superimposed on a pre-existing vascular occlusion, terribly complicates the injury and final result.

If the extremity has remained in a frozen state for some considerable time, even rapid thawing and general supportive care may not be effective in restoring the circulation and a condition similar to anterior tibial compartment syndrome may be demonstrated clinically. *This problem may require fasciotomy.* This condition can be determined either clinically, or by measuring compartment pressures, by the use of arteriography, or injection of isotopes such as technetium 99^{m}. The use of split thickness skin for large granulating areas or areas where skin cover is considered proper may have skin applied from the

third to the fourteenth day. The results of skin graft are best following thawing by rapid rewarming. The pedicle grafting of full thickness skin is a late procedure.

The use of a mesh skin graft at the time of fasciotomy or soon after, decreases the morbidity and lowers the incidence of scarring and infection.

The use of antibiotics is not necessary except in deep infection. Cotton pledgets between digits will prevent maceration of tissues. *Bedside digital exercises* of all the joints are recommended, this done throughout the entire waking day, and *Buerger's exercises for lower extremities are recommended 4 times daily.* Narcotics generally are not utilized in the uncomplicated cases after initial thawing. Tranquilzers or asprin will suffice for pain. *In the past, sympathetic blockade, sympathectomy, anticoagulants, vasodilators, alcohol, and enzymes* have not proved particularly effective.

In patients with apparently equal bilateral injury, however, results of sympathectomy within the first 24 to 48 hours have demonstrated that, while there is no further preservation of tissue, there is (1) decrease in pain, (2) marked decrease in edema, (3) much less infection, superficially or deep, and (4) early and more proximal tissue demarcation.

More recently, however, and still in process of evaluation, sympathectomy and vasodilators, and sympathetic blockade have been determined to be of good effect, following fasciotomy. I suspect the previous irregular results often reflected effort to perform effective sympathectomy when the problem may have included regional vascular compartment pressure block. Particularly effective for me has been the use of Phenoxybenzamine Hydrochloride (Dibenzyline), given 10 mgm. daily and increased to 20 to 60 mgm. per day, depending upon effect and need. The drug is used for vaso spasm and appears to be an effective alpha adrenergic blocking agent. It is important that the patient be well hydrated after surgical or chemical sympathectomy.

Patients are kept in a pleasant environment, not relegated to corners of the hospital because of odor, or tissue necrosis. *The diet is high protein and high caloric,* with vitamin supplements as needed and of your choice. *When considered necessary, antitetanus therapy is recommended,* particularly toxoid booster for those previously immunized. If for any cause, amputation must be performed, a *modified guillotine procedure at the lowest level* is recommended with secondary closure to be done at a later date. Dislocations and fractures pose interesting problems, and the *dislocation particularly should be reduced immediately* after thawing. *The use of traction or trauma or manipulation or open procedures are done seldom* and only then very carefully, in the patient who had extremity fracture prior to his freezing. *The fracture treatment should be conservative* until the post thaw edema is eliminated. It may be that a well padded plastic mold is the best method of treatment until there is cessation of edema. If open reduction of fractures or dislocations is required, great care must be utilized to avoid further vascular injury. Postoperatively, the operated part in a plastic posterior mold may still undergo whirlpool therapy and active digital exercises. The prognosis of this combined injury is poor because of injury to the regional vascular supply from fracture trauma, and then the added insult of superimposed freezing injury. *It is here that fasciotomy may be required to* relieve the deep structure pressures. Fluids are encouraged, dehydration is to be avoided and electrolyte balance maintained. *Smoking is discouraged;* alcohol may be permitted.

The above is a basic program to which you may add any other therapy of choice including, low molecular weight Dextran, vasodilators, anticoagulants, or other indicated drugs of choice.

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MOUNTAIN MEDICINE SYMPOSIUM

THIRD DAY PROGRAM

DEVOTED TO

ACUTE MOUNTAIN SICKNESS

CEREBRAL EDEMA (CE)

HIGH ALTITUDE PULMANARY EDEMA (HAPE)

HEAT ILLNESS

CLOTHING AND EQUIPMENT

FOOD AND NUTRITION

GROUP DISCUSSIONS:

Mountain Sickness and CE
HAPE
Mountain Miseries
Clothing and Equipment
Food and Nutrition

THE INCIDENCE AND IMPORTANCE OF ACUTE MOUNTAIN SICKNESS

By

Peter Hackett

Peter Hackett spent 18 months manning an aid post at the tiny village of Pheriche which is at an altitude of 14,000 feet, astride the main trekker's route to the base camp on Everest and Kala Patar above it. The full results of his studies are reported in the paper "The Incidence, Importance, and Prophylaxis of Acute Mountain Sickness" by Peter H. Hackett, Drummond Rennie, and Harry D. Levine in the Lancet of November 27, 1976, Page 1149 to 1155. In this edition of the Lancet, there is a leading article "See Nuptse and Die" on Pages 1177 to 1179 which will give, to those who are medically inclined, a very full background and bibliography.

Peter handed out questionnaires and examined trekkers and tourists of every degree of fitness and motivation as they passed through Pheriche on their way up to see Everest. Scoring the various symptoms of acute mountain sickness in an arbitrary, but fairly well accepted, manner the study on 278 unacclimatized hikers showed a high incidence of AMS (53%). There was a clear indication that the younger the trekker, the more severe and the more frequent the symptoms of acute mountain sickness. This was so even when allowances were made for the weight carried and speed of ascent. The rate of ascent was the single most important factor related with the onset and severity of acute mountain sickness. It was quite clear that those who gained altitude fast were far more likely to develop acute mountain sickness and those who spent extra nights acclimatizing at Pheriche were less likely to do so.

There was no difference in incidence between the two sexes, nor had the group who had acute mountain sickness less previous mountaineering experience and there was no evidence that they carried greater loads or had had recent colds and upper respiratory infections.

There were seven cases of high altitude pulmonary edema and five with the more intractable cerebral edema of high altitude. Of these 12 patients with very severe acute mountain sickness, 11 had flown into Lukla at an altitude of 2,800 meters, 9 had spent only one night acclimatizing at Pheriche and none were on diamox (Lederle).

A very careful study was done with diamox and it was shown that whereas those who trekked in all the way from Kathmandu had less mountain sickness and certainly less severe mountain sickness than those who flew into Lukla and started the trek already at high altitude, diamox had a definite prophylactic effect in those who flew in (but none at all in those who trekked in).

The conclusion to be reached was that diamox should be taken only if altitudes had to be reached rapidly in an emergency. It seems ridiculous to take tablets, even if they are effective, to prevent an illness merely so that people can rush up and down mountains with relative safety.

Emphasis was put on the need to take things slowly, to diagnose severe mountain sickness early, and to evacuate to lower levels immediately, before the problem got so severe that the patient either was in danger of dying or required very major evacuation efforts to be saved.

Basically the study put on a numerical basis in large numbers of trekkers under easy conditions the fact that acute mountain sickness is common, preventable, dangerous, and treatable by immediate descent. The study also showed that diamox was effective but only in those people who for some reason found it necessary to fly to high altitude rather than use their own feet.

ACUTE MOUNTAIN SICKNESS AND HIGH ALTITUDE CEREBRAL EDEMA

By

Drummond Rennie, M.D.

If you wander down from the top of Mt. Logan, 19,850 feet high, here photographed from the North Peak, at around 19,000 feet, passing the West Peak, and MacArthur, you can turn and view the whole, colossal pile before descending to the quiet reality of the Arctic Institute of North America and meet the director of the High Altitude Physiology Study, Dr. Charles Houston, the first man to put high altitude pulmonary edema on the man, the first to describe cerebral edema of high altitude and the first to recognize retinal hemorrhages of high altitude. He is a great personal friend and inspiration---and really the instigator of this series of conferences.

You will wonder what is going on--and what is going on is a very serious attempt to explain the manifestations of acute mountain sickness, not merely to make mountaineering safer and more pleasant, but to shed light on many other related, similar and dangerous conditions occurring to patients at sea level.

We shall discuss this afternoon two facets of Acute Mountain Sickness, cerebral edema and pulmonary edema; both of them potentially killing conditions. It is no accident that the brain problems have been delegated to me--that though Dr. Houston and Dr. Dickinson have written the first comprehensive paper on cerebral edema of high altitude, I should be up here as living evidence of its effects. Both have, in Medicine, many causes, but here I am referring exclusively to the conditions occurring at high altitudes: being "high" as we know, means being short of oxygen. The discovery of the disorder and the element almost coincided.

John Mayow, in 1674, showed that there was something in the atmosphere which an animal required for life and when the animal had used up this something--like this rat in a bell-jar, it died. A little earlier, a Belgian chemist, Johann Baptista van Helmont, had performed a similar experiment with a candle. Both experiments were repeated by Stephen Hales, in 1727, who showed that the animal used up one-thirteenth part of the atmosphere before dying, whereas the candle used up one-eleventh before going out.

The great scientist, Robert Boyle and others after him had developed the mathematical relationships between the volume, pressure and temperature of mixtures of gases and Blaise Pascal (mathematician, philosopher and father of both the study of probability and hydralics), following Galileo and Torricelli, measured barometric pressure (the weight of a column of air above any point) and showed that it was three inches of mercury lower at the top of the Puy de Dome (3,200 feet up) than at the bottom. An austere Jansenist, Pascal's probability calculations were designed to help camblers on the one hand and prove the existence of God on the other, a proof which, unlike his barometric experiments, has been much criticized. If you had just flown from the Logan High Camp (17,600 feet) 15,000 feet down to Kluane with sealed plastic bottles half full of urine, you could have made the same discovery.

At the end of the 18th Century, the Swedish apothecary, Carl Wilhelm Scheele, and the English chemist, Joseph Priestly (1774), discovered what that combustion-supporting, fire-air was, but it was really Antoine Lavoisier, chemist, tax-commissioner, agriculturalist and politician, who isolated and

named oxygen for the first time, putting an end to the phlogiston therory forever. His experiments were exactly contemporaneous with those of the remarkable scientist and mountaineer, Horace Benedict de Saussure, who was publishing the results of his physiological, meterorological and geological studies, many of them made at high altitude on Mont Blanc--a mountain that was climbed very largely because of his interest, enthusiasm and money and of which he made the second ascent. De Saussure had plenty to say about the discomforts of mountain sickness.

Simultaneously, in this extraordinary age, the Montgolfier brothers had successfully launched the first balloon--a hot air machine which was succeeded by the hydrogen balloon of the French Physicist, Charles, and the disastrously combined hot-air and hydrogen balloon of Madame Blanchard. The balloonists were soon experiencing the very acute and immediate effects of hypoxia, or lack of oxygen.

Ballooning reached its culminating point in 1875 with the astonishing scientific flight of Tissandier, Croce-Spinelli and Sivel, who reached a height of around 25,000 feet; when they reached the ground again, Tissandier was unconscious, the other two were dead--like Mayow's small animals, these were deaths from acute hypoxia.

Paul Bert, lawyer, engineer, physiologist, pioneer of transplantation, botanist, anatomist, founder of Aerospace Medicine, politician, anti-cleric, woman's libber who solved the problem of Caisson disease, or "the bends" in divers and who finally became Governor General of French Indo China, (where he died at age 48) published in 1878 "La Pression Barometrique," a book nearly 1200 pages long, half of it devoted to the history of high altitude physiology and the rest to his formidable researches. In this book, there are numerous descriptions of acute mountain sickness and equally many of the acute effects of hypoxia, here seen in a patient--a student, with very severe and eventually fatal pneumonia.

Meanwhile, Edward Whymper was one of the more determined enthusiasts leading climbers in ever increasing numbers into the mountains to enjoy the sport and ensure that there would be plenty of people around to get acute mountain sickness.

What is Acute Mountain Sickness? I shall leave the description to Dr. T.H. Ravenhill, physician to a mining Company up in the Andes near the Chilean-Bolivian border. He wrote this in 1913, and I like it because his classification fits in with mine. He had an ideal opportunity, as he recognized, to see people who had been taken up effortlessly (by rail--the only effortless method) to high altitude in a short time (that is to around 16,000 feet in 42 hours from the coast), unaffected by exercise, fatigue, insufficient food and the normal trials of mountaineers. "It is a curious fact that the symptoms of puna (Acute Mountain Sickness, or "Soroche" in Peru), do not usually evince themselves at once. The majority of newcomers have expressed themselves as being quite well on first arrival.

As a rule, towards the evening, the patient begins to feel rather slack and disinclined for exertion. He goes to bed, but has a restless and troubled night, and wakes up next morning with a severe frontal headache. There may be vomiting, frequently there is a sense of oppression in the chest, but there is rarely any respiratory distress or alteration in the normal rate of breathing so long as the patient is at rest. The patient may feel slightly giddy on rising from bed, and any attempt at exertion increased the headache, which is nearly always confined to the frontal region.

On examination, the face may be slightly cyanosed; the eyes look dull and heavy, with a tendency to water; the tongue is furred. The pulse is nearly always high, being generally in the neighborhood of 100 or over. 150 was the highest in my cases. The temperature is normal at first, though it may rise towards evening. There is at times reduplication of the pulmonary second sound. The patient feels cold and shivery.

The headache increases towards evening, so also does the pulse rate; all appetite is lost, and the patient wishes to be left alone--to sleep if possible. Generally, during the second night he is able to do so, and as a rule wakes next morning feeling better; the pulse rate has probably dropped to about 90; the headache is only slight. As the day draws on, he probably feels worse again, the symptoms all tending to reappear on any exertion; if, however, he keeps to his bed, by the fourth day after arrival he is probably very much better, and at the end of a week is quite fit again. The most prominent feature in this type of puna is frontal headache and extreme lassitude."

He notes all the principle features of Acute Mountain Sickness: Its occurrence after rapid ascent, even without exertion, to high altitudes; its delayed onset in particular separated it from the acute effects of hypoxia described by the balloonists.

Ravenhill then goes on to note two very serious and even fatal divergences from the "normal" type of acute mountain sickness, or puna, as it was called in the Andes, a "cardiac" form and a "nervous" form. He gives descriptions of three cases of the "cardiac" form of puna, one of whom was successfully evacuated to the coast, but the other two died. There is no doubt at all that these cases were really cases of pulmonary edema. Ravenhill, interestingly enough, noted that this condition was not associated with weakness nor disease of the heart beforehand even though he thought that the altitude must affect the heart to cause heart failure.

In my talk, I will keep naming hypoxia as the primary cause of the syndromes associated with acute mountain sickness, but I am very fully aware that there are numerous other factors at work in individual cases: exertion, fatigue, heat, sunlight, cold, dehydration, worry about home, malnutrition and fear to name only a few, all but the last being exemplified by these two pictures of Hermann Buhl just before Nanga Parbat, and on returning to the top camp after his solo ascent and bivouac. It is important to remember all the other influences on the body beside hypoxia: as in Pete Lev before and after Dhaulagiri.

I would like to follow Ravenhill's broad classification, modifying it in proposing that there are two main types of acute mountain sickness, and that <u>both</u> are due to water being in the wrong place.

There is water in the brain which causes the symptoms of acute mountain sickness, and, if very severe, this constitutes cerebral edema. There is water in the lungs, as you shall hear from Dr. Herb Hultgren, and if this is severe, it manifests itself as pulmonary edema. I am going to explain what I understand by these statements, but first, does this matter? Yes. The two extreme manifestations of acute mountain sickness <u>kill</u> people, and because these are people who go up into the mountains, they kill the young, the fit, the enthusiastic, the audacious and the physically hard-working, and they are killing them in ever-increasing numbers--remember, some 11,000 tourist trekkers went to Nepal last year alone--and can you blame them? In short, people taken suddenly to high altitude, spring internal, fatal, leaks.

I shall discuss water in the brain--causing Acute Mountain Sickness if there is only a little, and the signs of severe cerebral edema if there is a lot--and Dr. Hultgren will discuss pulmonary edema, which may be partly caused by cerebral edema and which undoubtedly mades cerebral edema very much worse. Pulmonary edema is probably more common than cerebral edema but as cerebral edema is far harder to treat, in Kimalayas at least it is a more serious problem.

CEREBRAL EDEMA

What causes cerebral edema? I have already mentioned that I think that this is due principally to water getting into the cells of the brain, the brain being 80% water anyway. What evidence is there for this? Looking into the old literature, it is very interesting that Forbes and his colleagues at Harvard back in 1924 (which is the year that Mallory and Irvine perished near the summit of Everest, 52 years ago), discovered that if they made dogs or cats very short of oxygen by making them breathe carbon monoxide, and if this was done suddenly, the animals developed a considerable vasodilatation of the cerebral and retinal vessels.

If this was done more slowly, there was an increase in the brain volume due to water getting into the cells. This increase in brain volume could be cured by running high concentrations of a saline solution into the animal's blood stream. This solution would suck water out of the brain cells and shrink them by osmosis. (I am also interested in this work because cases of "acute mountain sickness" at sea level in heavy cigaret smokers with high blood carbon monoxide levels have been described and it has been claimed that cooking in sealed tents can precipitate illness at high altitude because of carbon monoxide accumulation).

Obviously, cerebral edema is a rather difficult phenomenon to investigate in man. The great Italian altitude physiologist, and archeologist, Angelo Mosso, working at the turn of the century in Turin and on Monte Rosa, had early on wondered whether the cause of acute mountain sickness was dilatation of the blood vessels going to the brain. A small dilatation would, in a situation in which only 75ml of blood are contained within the brain at any one time, but 750ml of blood are pumped through it every minute, cause a big increase in pressure. His clinical observations, which again fit in with Ravenhill's and our own, made him believe that all the signs and symptoms of acute mountain sickness were fundamentally due to an upset of the nerve centers, placed at the base of the brain, which controlled all the vital functions such as the heart rate, breathing and so on. In Mosso's famous "Life of Man on the High Alps," he starts one's chapter entitled "Circulation of the Blood in the Human Brain" with the memorable words: "It was my wish to find some man with a hole in his skull who would be willing to come with me on the Monte Rosa Expedition, but I was not successful in my search. Some other physiologist will, I hope, be luckier."

Mosso was imagining what would happen if the pressure in the brain was raised. The skull is a rigid box: the brain has nowhere to go. The signs and symptoms of raised intra-cranial pressure depend on the speed of its onset and its severity, just as in the animals whom Forbes asphyxiated with carbon monoxide.

In fact, worse than having nowhere to go to, the brain tries to bulge out through rigid holes and past rigid projections. This not only fuddles the intellect, fogs the psyche and dulls the emotions, it can paralyze, render unconscious, stop the breathing and kill, and do so in a matter of hours.

The theory then is that on exposure to high altitude water gets into the brain. At the same time, there is dilatation of the blood vessels. In other words, both brain cells and blood vessels attempt to take up more space: it is known that cerebrospinal fluid pressure is definitely increased in cerebral edema of high altitude.

The skull, as Hansen and Evans have pointed out, is a box with holes covered by semielastic membranes. By Pascal's law, small volume changes large pressure changes. Large pressure changes cause everything from headache to slowing of the pulse to insomnia to death.

Why should water go into the cells at high altitude? This is arguable. It is probable that the cells (which ordinarily expend energy pumping out sodium) aren't very good at keeping sodium and therefore water out when they become hypoxia since hypoxia damages the "pump". (If you disbelieve in "pumps" and regard the cell as some sort of ion-exchange resin, you still have to presuppose energy-requiring processes which need oxygen). Leakiness of the tiny blood capillaries themselves probably does not occur in hypoxia as the first or initiating factor (vasogenic edema), but this "poor-pump", "cytotoxic", sickle-cell edema is known to occur in seconds with severe, acute hypoxia. It <u>may</u> occur at high altitude over a longer period--this is unproven. Capillary leakage almost certainly occurs later, and even more importantly, swelling of the cells of the minute blood capillaries themselves, so that they close off, circulation ceases and hypoxia and edema worsens.

Mosso got hold of two boys with holes in their skulls. In experiments with the first in a low-oxygen chamber, he seemed to show dilatation of the vessels, but he could not show it with the second. In fact, we now know that the cerebral blood flow increases about 30 or 40% at altitude and there is an associated dilatation of the cerebral vessels. These dilated vessels may compress the entire brain evenly or just cause local signs by pressing on particular parts of the brain, for example, that part in control of balance.

If the cerebral edema (swelling of all types of brain cells and of the walls of the blood vessels) becomes very severe, the cerebral blood flow just simply stops---so does the climber. At the same time, as I have said, there may actually be blockage of some of the brain capillaries--the smallest blood vessels--and numerous little hemorrhages. It is certainly known that the cerebrospinal fluid pressure is increased in cerebral edema. In two cases of cerebral edema at high altitude brought to autopsy, as recently described by Dr. Charles Houston and Dr. John Dickinson, the bulging brain has been found to be covered with tiny hemorrhages as well as bigger ones within it. Big or small, these hemorrhages do the brain no good at all, and they certainly indicate very severe, even catastrophic, cerebral upheaval, like gun shot in a computer.

If one assumes that the eye is window not merely to the soul, but also to the brain, then perhaps when we look into the eye and at blood vessels lying on the retina at the back, we are also being given a clue as to what is happening within the cerebral vessels locked within the bony skull.

In our group, headed by Charlie Houston, Dr. Regina Frayser, has spent a great deal of time taking retinal photographs and measuring retinal blood flows on the plateau of Mount Logan in the Canadian Yukon. I have also continued this work on Dhaulagiri I, in the Himalayas, during the 1973 American Expedition.

In both situations, there was a 20% increase in diameter of arteries and veins in people taken to high altitude (17,500 feet on Logan or, at Base Camp on Dhaulagiri, 19,400 feet). This dilatation was associated with a big decrease in the amount of time taken for the blood to go through the eye and so a big increase (%) in blood flow. On Logan, Regina Frayser measured blood flow by injecting fluorescent dye into an arm vein and watching it go through the eyes.

The vessels, then, become fat and dilated and showed an increased flow. They also burst, forming mini-hemorrhages which occurred in about 1/3 of people on Logan and 1/3 of the climbers on Dhaulagiri. This showed that they weren't related to the absolute height reached, nor to the level of exertion, both of which were very much higher on Dhaulagiri. This is a complicated matter, however, because the Dhaulagiri climbers had selected themselves out as being people who did well at very high altitudes. Perhaps an unselected group at these higher altitudes would have had a higher incidence of hemorrhages--but how do you get an "unselected group" to 25,000 or 26,000 feet? (Recently Charles Clarke on Everest reported retinal hemorrhages in Sherpas).

Why do these hemorrhages--retinal and cerebral--occur? Well, when you're straining, for example, on the pot, or lifting weights, or when doing a Valsalva maneuver or having a prolonged coughing fit, the pressure in your thorax goes up enormously. (The pathophysiology of weight-lifting is beautiful in a macabre way.) There are frightening physiological studies published by Lind and his co-workers which show that just picking up weights by the arms will increase your blood pressure enormously. Think of this next time you carry a suitcase. You should definitely put it in a rucksack.

I coughed enough to go unconscious at 23,500 feet and broke two ribs in the process--or found I had done so when I woke up hanging from the fixed rope on my jumars. These intrathoracic pressures are, I believe, referred directly along fully dilated vessels to the already damaged and dilated capillary vessels in the eye and brain and in the brain the vicious cycle of hemorrhage, increased pressure and worsening cerebral edema occurs. What is important is the idea of sudden very high pressures being transmitted along vessels which cannot protect themselves from bursting by immediate constriction. Of course, there may be clotting going on within the brain capillaries which increases the hemorrhaging tendency. This is speculation, but not, I believe, idle speculation. The retinal hemorrhages subside spontaneously, rarely leaving any permanent visual defects. It is quite unclear whether they, of themselves, constitute an indication to descend, though there is, I believe, evidence that as with all other manifestations

of acute mountain sickness, they occur associated with heavy exertion and rapid ascent. Failure of 'auto-regulation' may occur, the arteries mostly dilate due to lack of oxygen but perhaps some few constrict because of the low CO_2 . This is the 'HASH' theory - or the Hultgren - all screwed up hypothesis!

Under what circumstances do climbers get Acute Mountain Sickness or cerebral edema? It is essential to remember that there is an absolutely stupendous variation from one climber to the next. This variation is seen in all forms is Acute Mountain Sickness. It may attack perfectly normal people. It infuriated Whymper and Ravenhill was intrigued by it. First Ravenhill: "There is, in my experience, no type of man of whom one can say he will, or will not, suffer from puna. Most of the cases I have instanced were men to all appearances perfectly sound. Young, strong and healthy men may be completely overcome; stout, plethoric individuals of the chronic bronchitic type may not even have a headache." On Chimborazo, at 16,664 ft., Whymper, the foremost mountaineer of his age, was having a bad attack of acute mountain sickness and was placed, with his companions, the two Carrels, completely out of action. Whymper wrote: "Strange to relate, Mr. Perring did not appear to be affected at all. Except for him, we should have fared badly...." He records that Mr. Perring kept the fire going, fed them and brought them drink and attended to their wants in general: his conduct was exemplary. Yet, at sea level, in the normal course of things "he was a rather debilitated man, and was distinctly less robust than ourselves. He could scarcely walk on a flat road without desiring to sit down, or traverse a hundred yards on a mountainside without being obliged to rest." One can summarize by saying that AMS (and cerebral edema) occur in some individuals who go too high for themselves. Some may be stricken below 9,000 feet and others at 19,000 feet: speed of ascent (going up too fast, with too heavy loads) accounts for only part of the difference. The moral is: stick to Wales.

Acute mountain sickness implies not merely that the altitude is too high for any one individual, but that it was reached too fast. Again, there is tremendous variation. Dr. Charles Houston records one skier who "took five days to get from 7,500 to 10,500 feet (which is about as slow as it's possible to be), not hard work, and there became comatose and had cerebral and pulmonary edema and retinal hemorrhages and would have died but for rescue by chopper...."

Mount Kenya, which is about 17,770 feet, is 2,000 feet lower than Kilimanjaro but apparently has a far higher incidence of acute mountain sickness than Kilimanjaro because Kenya can be climbed extremely rapidly by people who are on package tours whereas Kilimanjaro forces one to spend several days trekking across country at quite high altitudes first. This, I believe, accounts for the fact that at the beginning of this century it was generally accepted that acute mountain sickness occurred much more commonly in the Andes: only in the Andes was there efficient transport--trains--capable of taking people rapidly from sea level to 16,000 feet altitude. One of the advantages of attacking Everest from the North is that one has to undertake a lengthy forced acclimatization march en route. In 1962, the Chinese did this in rather large numbers, though they missed out Everest and attacked the Indians instead. Very large numbers of Indians, flying up from the Ganges Valley, were overcome by acute mountain sickness

and pulmonary edema. As we have repeatedly pointed out, acute mountain sickness (with its children, pulmonary edema and cerebral edema) are very much diseases of civilization: affluence, the desire for profits and impatence resulting in trains, cars, planes, helicopters and tight schedules. Everything conspires to push people too high, too fast, wafting them up to a graceful landing on te snows: and trouble. In the paper, over which Pete Hackett, I have sweated wo much, we point out that of the 278, the 12 who had 'severe AMS' all flew to high altitude - none trekked - none took diamox, none spent an extra acclimatizing night at Phenche, all had a high rate of climbs.

Once at 15,200 feet on Defourspitze of Monte Rosa, a man I was climbing with became absolutely crazed and wanted to throw himself down the Macugnaga Face. After considering this proposal, we trussed him to a rock and, while having lunch, I meditated on the effects of a little cerebral edema. Two or three years latter, and more than 2,000 feet gigher, I was able to meditate, fuzzily, on the effects of plenty of cerebral edema--in the patient who was a pilot for the Canadian Forces, as well as a cross-country runner and who, 30 hours after being flown to 17,500 feet, was evacuated by air because he was deeply unconscious with retinal hemorrhages and papilledema--swelling of the optic nerve indicating cerebral edema.

The only drug that has been consistently shown to be of prophylactic use in Acute Mountain Sickness is one that is known to have quite profound effects upon the brain. This is Diamox (Acetazolamide). It is known transiently to raise the cerebral blood flow, but it reduces the formation of the fluid that bathes the brain, the cerebrospinal fluid, and reduces the pressure of this fluid. It tends to increase breathing by making the cerebrospinal fluid acid and it also acts as a mild diuretic, though this is probably its least important action in this connection. If taken before going up alnertly to high altitude and for a few days afterwards, Diamox probably reduces the incidence of acute mountain sickness. It also ruins the taste of beer. It is not known if it reduces the incidence of cerebral edema, but we believe it does.

As I would emphasize were I to be discussing pulmonary edema (a much commoner serious manifestation of acute mountain sickness than serious cerebral edema), I am against taking prophylactic drugs before ascent unless in an emergency because by far the best and truest prophylactic is to go slowly and only go as high as <u>you</u> (not the others) feel fit to go. I cannot exaggerate the importance of prevention by simple common sense. Going slowly, and acclimatizing on the long Tibetan march-in, Norton, standing here, with Mallory et al in 1924, climbed to 28,100 feet without additional oxygen and Mallory was able to write this letter in beautiful characters in a tend above 27,000 feet: they allowed themselves to acclimatize: contrast this writing with the writing in my two sick, suddenly hypoxic, 'unacclimatized' patients.

With AMS, by <u>far</u> the most important thing is to prevent it. Every effort should be made to go up the mountain slowly at first, the pace varying with the individual. Most people will be all right if they fly to 10,000 feet, spend two days there; climb 1,000 feet a day to 14,000 feet and thereafter 500 feet a day. Be intelligent about fixing climbing schedules. If you need convincing; remember this graph: the higher the mountain, the lower the oxygen. There you see candles under different oxygen. pressures. Carry high and sleep low, don't take gigantic loads

huge distances, but divide them up, take longer and allocate more time and smaller loads. This advice I know to be very unpopular and, therefore, unacceptable. One three-month expedition to Logan came to us for advice on acute mountain sickness. We gave it. The very next day they flew to 9,000 feet, climbed for a whole night and a day to 12,000 feet and at 14,000 feet their youngest member almost died from pulmonary edema with cerebral edema and retinal hemorrhages like this.

I am personally against taking pills to prevent these diseases. They may be effective but often give a false sence of security no substitute for intelligent planning; moreover, they have toxic effects.

Recognition. Always be suspicious of C.E. when climbing at highish altitudes, and that means anything over 10,000 feet, and just keep your eye on your companion. It is not known whether, if a man has had cerebral edema before, he will be more likely than the next man to have it again. Is he behaving in an appropriate manner? As with heat stroke, hypothermia or exhaustion you ask yourself: is he more tired than you would expect? Is he being logical, appropriate, energetics. Are you? Or is he groaning in a tent corner, demanding to be left alone, refusing food and fluids, staggering, falling about and vomiting. If asleep, can he be roused? Is he really unconscious?

What is the treatment of cerebral edema? The first and absolutely imperative thing is to get the person down to lower altitudes. Even quite a small decrease in altitude may save somebody's life. Dr. Houston recorded one man who drove his car up to 8,400 feet and then continued on skis, carrying a pack, who was deeply unconscious at 10,500 feet, but recovered consciousness when brought down 2,000 feet to 8,400 feet, though only after afurther two days of coma. I have seen this sort of thing several times. Whatever other procedures that you intend to do, for heaven's sake get the person down even if it means doing it at night and under bad conditions, because this will save the person's life. In this way, for example, Al Read's life was undoubtedly saved when he went unconscious on Dhaulagiri in 1969. Do not wait for the critical helicopter and promises of them. They can get lost, or crash, or not exist and they involve dangers for the crew.

Give oxygen in the unlikely event that you have it to give, but do not delay getting the person down because you've got oxygen with you. I came across this delightful apparatus, dating from the first world war, for injecting it. You'll need a little more: 6 to 8 liter per monute if you can spare it and using a tight-fitting mask.

It seems to me that climbers will go to great lengths to avoid being given injections of drugs by other non-medical climbers. However, in a nauseated, vomiting or unconscious man, pills may not go down--or stay down. Neurosurgeons will give steroid tablits or injections to decrease cerebral edema and if you've got a doctor who has diagnosed this condition, then you should do the same: Prednisone, Dexamethasone or Betamethasone. We would give 10mg of Dexamethasone into a vein and then 6mg every hours into the muscles. Steroids begin to work in 6 hours, however, and a maximal effect takes 24 hours. Before you go to high altitude, get a doctor to show you how, and where, to give intramuscular injections, and with what steroid. Diamox reduces the formation of C.S.F., as I have said, but is probably ineffective in this situation. The place of fluids in this condition--

and of diuretics--is totally obscure as they have never been put to rigorous statistical trial.

Osmotic diuretics (such as 20% mannitol) (or the hypertonic saline used by Forbes in his cats and dogs) will such the person, and his brain, dry like a prune but they are difficult to give. Mannitol requires a blood infusion apparatus and probably bladder catheterization as well, and is really not feasible on any but large expeditions. Injectable solutions tend to freeze and it is really awkward giving intravenous injections in very sick patients in a cramped and frozen tent. More important, perhaps, is the simple care of the unconscious patient which includes turning him on his side, cleaning his vomit out of his throat and catheterizing his bladder. This last is something I have had to do at high altitude, but it is not something a layman should be asked to do.

Practically, then, if you think someone has cerebral edema, get them down, but as the condition is very awkward to manage and can be rapidly fatal, prevent it by going up the mountain in a leisurely manner.

I have talked about going high and, therefore, of going hypoxic, I have proposed that one of the body's responses to this is to shift water, either into cells (for example, into the brain, causing acute mountain sickness or, rarely, cerebral edema) or into the alveoli of the lungs--which is pulmonary edema. I have emphasized that these are very dangerous conditions, potentially fatal to sufferers and rescuers alike and that the treatment is descent, rest and oxygen, but that treatment is difficult, hazardous and chancy whereas prevention, by leisurely ascent, is too simple and too obvious that no none will ever accept it in this impatient world. But if you want to live to enjoy the mountains high up, and drink them in to return rejoycing to the glorious green, lush world at sea level, that's what you'd better do.

HAPE
High Altitude Pulmonary Edema

by
Herbert Hultgren, M.D.

Pulmonary edema is the presence of excessive fluid in the air sacs (alveoli) of the lung which interferes with the absorption of oxygen by the small blood vessels (capillaries) of the lung. The human lung contains millions of tiny alveoli which are ventilated by breathing. Each alveolus is surrounded by thin walled capillaries. Oxygen is absorbed from the alveoli by the capillaries and carbon dioxide is liberated from the capillary blood into the alveoli. Normally the lungs are dry, i.e., all alveoli are filled with air. When the pressure in the capillaries is elevated above a critical level fluid will leak into the alveoli. Small amounts of fluid can be removed by the lymphatic vessels of the lung. If large amounts of fluid enter the alveoli from the capillaries the normal fluid removal mechanisms are overwhelmed and alveoli fill with fluid. The fluid may also fill up the branches of the bronchial tree which communicate with the alveoli. This will result in coughing, and gurgling sounds in the chest which are two common signs of pulmonary edema. When pulmonary edema is severe oxygen cannot enter the fluid filled alveoli to reach the capillaries and the oxygen saturation of the blood falls. When the level of blood oxygen saturation falls below a critical level the brain will not function normally and headache, mental confusion and ultimately coma or unconsciousness occur. Breathing activity which is controlled by the brain will slow and eventually stop. Death from pulmonary edema is primarily due to inability to oxygenate the blood and not to heart failure. Essentially the process is one of drowning in one's own fluid.

High altitude pulmonary edema (HAPE) occurs when susceptible individuals who are not acclimatized ascend rapidly to altitudes exceeding 8,000 feet. The higher one ascends and the more rapid the ascent the greater is the possibility of developing HAPE. Engaging in heavy effort upon arrival at high altitude facilitates the development of HAPE. The initial symptoms consist of undue fatigue, weakness and shortness of breath. Symptoms of acute mountain sickness such as headache, loss of appetite or nausea may be absent. Symptoms usually begin one to three days after arrival at high altitude. Cough, shortness of breath at rest and gurgling sounds in the chest occurring during the night indicate the presence of severe pulmonary edema. As the edema worsens the patient may cough up large quantities of watery, foamy sputum often streaked with blood. Blueness of the lips, nose and finger tips indicate that oxygen transfer from the lungs to the blood is seriously impaired. Disturbances of mental facilities or consciousness such as confusion, hallucinations or stupor are ominous signs of severe hypoxia and precede death by 6 - 24 hours. Prompt treatment consists of: (1) Early recognition of mild cases; (2) Prompt descent to a lower altitude; (3) Oxygen administration; (4) Bedrest. HAPE is prevented by acclimatization, gradual ascent, avoidance of extreme exertion during the first few days of altitude exposure, bedrest for 1-2 days if mild symptoms or signs are detected or descent if symptoms persist. Lasix is of no value in preventing HAPE but Diamox may be helpful in certain individuals.

High altitude pulmonary edema occurs most frequently in climbers but skiers, trekkers and visitors to high altitude areas are also experiencing HAPE with several fatalities per year in the United States alone.

In 1976 a total of 826 persons attempted to climb Mt. McKinley. There were 10 deaths, and 11 episodes of HAPE. Two climbers died of HAPE.

The following is a summary report of HAPE occurring in California in a skier.

A 41 year old healthy, athletic man drove from sea level to a ski resort on the east side of the Sierra Nevada. He stayed at a lodge at 8,500 feet and skied between 8,500 feet and 10,000 feet for two days. On the second day he noted increasing fatigue, weakness, shortness of breath and mild fever. He consulted a local physician who took a chest film which showed a small infiltrate in the right lung. A diagnosis of pneumonia was made and penicillin was administered. The patient continued skiing but felt no better. He was given penicillin again but symptoms persisted while skiing for two more days. On the sixth day after arrival the patient retired to his room feeling extremely weak and dyspneic. He was found to be disoriented and extremely ill a short time later. Evacuation to a nearby hospital was carried out promptly.

Upon arrival at the hospital he was breathing rapidly, stuporous and could respond only to his name. His heart rate was 160 per minute, respiratory rate 30 per minute and the blood pressure was 105/60 mmHg. Moist rales were present over both lung fields. Cyanosis was present. No heart murmurs were noted.

Arterial blood gas studies revealed a po_2 of 32 mm. which increased to 51 mm. while breathing 100% oxygen. The pCO_2 was 32 mm. The packed cell volume was 52%. The white blood count was 21,500 with 80% PMN leucocytes.

A chest film revealed extensive patchy pulmonary edema in the right mid-lung field with moderate edema in the left mid-lung field.

An electrocardiogram revealed atrial flutter with 2:1 AV block. There were no other abnormalities and the serum enzymes were normal.

A diagnosis of HAPE was made and prompt treatment consisting of oxygen, digoxin and bedrest was instituted. Twenty-four hours later the patient was alert and free to symptoms. The arterial po_2 was 99 mm. on oxygen and the cardiac rhythm was normal. Three days after entry the chest was clear, laboratory studies were normal and the patient had completely recovered. Follow-up studies later that week demonstrated no underlying cardiac or pulmonary disease.

Comment:

This represents a typical, severe episode of HAPE occurring in a skier. If the diagnosis had been made during the first examination the edema would have subsided upon descent or after 2-3 days rest at the ski resort. Continued physical activity resulted in progressively severe edema with a marked decrease in arterial oxygen saturation as evidenced by stupor and the low po_2 of 32 mm. (normal values are 80-90 mm.). Atrial flutter is rare in HAPE but may occur as the result of a rise in pressure in the pulmonary artery and right ventricle. The prompt response to descent, rest and oxygen therapy with rapid clearing of the pulmonary infiltrate indicated that the primary problem was HAPE and not pneumonia. High altitude pulmonary edema is rarely seen in skiers in California since most ski lodges are below 7,000 feet. It is more common in Colorado where many lodges are above 8,000 feet.

One of the problems of investigating outdoor physiologic problems and, especially high altitude pulmonary edema (HAPE), is the difficulty of doing controlled research. There are no animal models of HAPE, and it is difficult to do careful research under adverse mountain conditions. For these reasons a lot of the things I'll be presenting this morning are still open to fair criticism and doubt, but these are due to limitations in obtaining adequate precise and controlled observations and not to imperfections in what work has been done.

I will now try to very briefly cover four aspects of HAPE: incidence, the diagnosis of a mild case, the treatment and prevention.

Everyone wants to know, what are my chances of getting HAPE under given conditions, or what are the chances that some member of my party will develop HAPE? Current observations indicate that the incidence of HAPE is related to both the altitude attained and the speed of ascent. This was well illustrated in India when troops were rapidly moved up to the border mountains during the war that occurred with China in 1963 and 1964. Approximately six percent of the troops moved from sea level to 14,000 feet by air developed HAPE that was severe enough to require hospitalization. These were young men, over half of them under 28 years of age. However, among those transported to the same altitude, 14,000 feet, in two days by lorry, the incidence was about one percent.

In Peru there have been more controlled investigations of the incidence of HAPE in people going from sea level to an altitude of about 13,000 feet in a travel time of about six hours which can be done by rail, car or air. This is approximately the altitude of Cerro de Pasco, La Paz, Bolivia and perhaps slightly higher than Cuzco. The incidence varied depending upon the age of the individual. In adults over 21 the incidence was 0.5% or 1 per 200. But with young people and adolescents under 21, the incidence was 12 times as high, namely 6 percent.

In all of these cases, HAPE was severe enough to require medical attention or hospitalization. However, many subjects sustain mild episodes of pulmonary edema, which they may not recognize except as minor discomfort for a few days. Even a physician may not recognize it unless he examines the patient or takes a chest film. This is called subclinical pulmonary edema, and there is evidence now that this occurs about three to five times as frequently as the more severe, incapacitating pulmonary edema. For example, Dr. Houston, in his study of climbers who ascended Mount Rainier (14,410 feet), found that on return to Paradise about 15 percent showed evidence of pulmonary edema. These climbers had some evidence of fluid in the lungs, determined by listening to their chest with a stethoscope. Unfortunately, this study has been discontinued and we do not have data on the appearance of the chest film in such subjects.

HAPE can be fatal. What are the chances that an individual with severe HAPE will die? The chances vary with the circumstances and the availability of treatment. The mortality may vary from one percent to as high as ten percent.

Certain subjects appear to be more susceptible to HAPE. Individuals who have had prior episodes are likely to develop a second episode at some future time. We don't know the incidence of this occurrence but it is higher than that of initial attacks.

HAPE occurs in unacclimatized subjects who go rapidly to high altitudes. In an individual is acclimatized, and descends to sea level for a period of longer than two weeks, he is then liable to develop pulmonary edema upon reascent. Reascent pulmonary edema was a common problem in troop movements in India where the soldiers return to the plains for a one to three month furlough and then go back to high altitude. Some investigators believe that reascent pulmonary edema is more frequent than first ascent pulmonary edema, but there are no solid data on this point. If an individual is acclimatized and goes down to sea level for a period of time of less than 14 days, he can go back up, apparently with no risk of developing altitude edema. Finally, even an acclimatized individual can develop altitude edema if he goes from a high altitude to a much higher altitude rapidly. Individuals acclimatized to 12,000 feet and performing very well can develop pulmonary edema if they make a very rapid ascent to 18,000, 19,000, or 20,000 feet. These are some of the general facts about incidence, mortality, and the nature of the occurrence. Most important, of course, is to recognize the early case. Whether you are a trip leader or a party member you want to identify the climber who has mild HAPE and prevent it from becoming a serious problem.

What are the signs of early pulmonary edema? First you have to realize that pulmonary edema occurs not on the first day after arrival at high altitude, but anywhere from the second to the fifth and sometimes the seventh day. Symptoms are frequently concealed, particularly by young climbers who do not wish to imply that they're out of condition or that they're poor climbers. So they climb slowly with increasing shortness of breath, fatigue, and weakness, while at the same time keep saying that they're perfectly o.k. The trip leader should watch for such climbers and realize that they may develop pulmonary edema especially during the night when HAPE may become worse instead of better.

If you suspect HAPE in a climber there are some very simple methods of making a preliminary diagnosis. The best method is to have the individual recline at rest in the tent, sleeping bag, or pad for about thirty minutes. When he is completely rested and effort induced changes in heart rate and respiratory rate are minimized, count his heart rate and rate of breathing. A heart rate of over 110 beats per minute at rest is an abnormal finding, and very common in early HAPE. A respiratory rate of greater than 16 breaths per minute is also abnormal in a resting state at high altitude, unless at an extremely high altitude. We are now talking about average altitude of 14,000 feet.

A persistent cough, not associated with a sore throat, fever, chills, or an upper respiratory tract infection, especially if it persists during the night, should be regarded as a possible early sign of HAPE. The cough may be irritating, persistent, and non-productive of sputum.

Finally, an individual in the early stages of HAPE has a peculiar sensation in his chest. You might call it shortness of breath at rest but it can be described in a slightly different manner. It is as if your chest was tightly bound with adhesive tape; you want to take a deep breath, but you can't do it, because your lungs are stiff and won't allow a full inspiration. One should listen to the chest for gurgles or rales. If you put your unaided ear against the back of an individual while he breathes slowly and deeply, in and out, you should hear nothing but a blowing sound as the air enters and leaves the lungs. If you hear crackles or gurgles, it's a sign of fluid in the lungs.

I think it's important for first aiders, particularly those who are specializing in mountaineering medicine, to have some training in the use of a stethoscope. It's valuable not only for picking up abnormal chest findings, but also for determining the heart rate and heart rhythm in individuals who've sustained a severe injury. A few hours practice with the help of a physician will enable most people to very easily recognize the abnormal chest findings characteristic of early HAPE.

The next question, of course, is what to do when you have an individual who shows signs of mild, early HAPE. The treatment here is fairly simple. There are two things that can be done. First, if the facilities and conditions permit he can go down to a lower altitude for two or three days of rest and recovery. A descent of even two or three thousand feet may result in a very rapid improvement. However, if he cannot be moved down, he should be treated by rest alone at that altitude. Now rest doesn't mean sleep during the day, it doesn't mean the administration of sedatives such as Seconal, it doesn't mean the use of codeine to stop cough. These three things - sleep, sedation and the use of codeine or similar preparations - will all depress respiration and when respiration is depressed, ventilation decreases, oxygen saturation falls and pulmonary edema becomes worse. In fact, most cases of altitude edema deteriorate at night when their respirations are depressed by sleep. So by rest I don't mean lying in a stupor with depressed respirations. The patient should stay awake, avoid sedatives and be encouraged to take 6-12 deep breaths every two to three minutes. Walking about in cold air will also stimulate breathing.

The patient should be observed every two to four hours, checking on the heart rate and respiratory rate, chest signs, and symptoms. If they are improving, they can remain at that altitude. If they are deteriorating, they should be brought down.

We don't need to say too much about the severe case of altitude edema. We are all familiar with the signs and symptoms. Most dangerous is a disturbance of consciousness. HAPE causes a very profound drop in oxygen saturation in the blood. Brain function is impaired, with the earliest sign being disturbances of judgment, incoordination and confusion. If this appears, it is a serious situation. The individual may then proceed into a semi-coma, where they are difficult to arouse, and on to complete coma or unconsciousness.

If an individual with altitude pulmonary edema goes into a coma (unresponsive), he's probably going to die within 6 to 12 hours unless something is done very quickly. The most important available method of treatment is prompt removal to a lower altitude. If he's able to walk, two or three people should go with him, because on the way down he may collapse and have to be carried. If he's already a severe case, and cannot stand or walk easily, he has to be brought down by litter.

What is the role of oxygen? Well, obviously every climber isn't going to carry oxygen to the top of every mountain just to treat a possible case of altitude edema. But larger parties at higher altitudes should have oxygen available at base camp so when a person comes off the mountain with altitude edema, he can promptly be given oxygen. The details of oxygen administration and the use of oxygen cylinders is pretty well known by most experienced climbers. Even though the present flasks available in hospital anethesia departments are heavy (about 18 to 20 pounds apiece) a six cylinder set weighing about 120 pounds will provide oxygen at two to four liters a minute for

approximately 24 hours. This is quite adequate to treat an acute case of HAPE until you can get down to a lower level or a hospital.

What is the role of drugs in the treatment of altitude edema? I personally feel there is no drug that is effective in treatment. We've heard many claims that the use of Lasix, a potent diuretic, may be helpful, but there are no systematic studies of the effect of this drug in a controlled situation that have demonstrated clear benefit. There are several reports of bad effects. Lasix is a very powerful diuretic and increases urine output rapidly. Even two tablets may cause the loss of two to four liters of fluid by way of the kidneys with a resulting drop in blood volume. When an individual is critically ill, and barely able to walk, and you decrease his circulating blood volume by a quart, he's going to become a litter case. This has actually occurred. Lasix has been given to an individual who was able to walk with assistance. After the diuresis he could no longer walk and had to be carried. There's no evidence that morphine or digitalis are of any value. I'm speaking now about treatment and not prevention.

What can be done about prevention? The most practical method is a staged ascent, allowing time for gradual acclimatization. There are some studies which indicate that two to four days of rest or light activity at an intermediate altitude is effective in preventing mountain sickness and HAPE. For example if climbing to 16,000 feet, a rest around 8,000 feet of two to four days will tremendously decrease the incidence of both actue mountain sickness and of HAPE. However, if you take four days to reach an altitude of 16,000 feet in gradual stages, you achieve a similar degree of acclimatization. A faster period of ascent may result in mountain sickness and HAPE.

HAPE cannot be prevented by medication. Diamox is effective in the prevention of mountain sickness. There is some evidence that Diamox may be beneficial in the prevention of HAPE. There has been one instance of a young skier with recurrent pulmonary edema in Colorado who no longer had episodes when he took Diamox prior to ascent. Diamox is not a powerful diuretic. It does not act by diuresis, but by an alteration in the acid/base balance of the blood. You will need a prescription from your physician. The usual dose is two 250 mg. tablets a day beginning the day before ascent and continuing for three days after arrival at high altitude. Diamox is relatively harmless but should not be continued for more than seven days. The most common side effect is tingling of the fingers and lips, and there is a report from Dr. Rennie that it makes beer taste unpleasant. But when Diamox is stopped, the symptoms go away.

Of course, you have to find a sympathetic physician to give you the prescription. At our Yosemite seminar, one member of the audience reported that he went to his physician and said he wanted some Diamox to prevent mountain sickness when he went climbing. The physician said, "you're a damn fool! Mountain climbing is dangerous. Stay home and you won't get sick." The physician was right but who wants to stay home all his life?

HEAT ILLNESS

Robert S. Mecklenburg, M.D.
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Syndromes of heat illness include heat exhaustion, heat stroke and heat cramps. Before discussing the causes of these diseases as well as the diagnosis and therapy, it is extremely useful to review the physiology of temperature regulation in the human.

PHYSIOLOGY OF TEMPERATURE REGULATION

Internal body temperature, or core temperature, is determined by the balance between heat production and heat loss. If heat production is greater than heat loss, body temperature rises; if heat loss exceeds heat production the reverse is true. Two major sources of heat production are (1) the basal metabolism, the heat produced by the many chemical reactions continuously proceeding in the cells of the body, and (2) muscular activity, which can increase heat production many fold.

MECHANISMS OF HEAT LOSS

There are three ways by which heat may be lost from the body: An understanding of these factors is important in avoiding heat illness. First, heat may be lost by radiation. All mass in the universe which is not at a temperature of absolute zero degrees radiates heat to the environment. The human body thus continually radiates heat to all other objects in the environment. In similar fashion all objects in the environment radiate heat toward each other and toward any person in that environment. If body temperature is greater than the average temperature of the environment, a net heat loss will occur by radiation. If the average temperature of the environment is warmer than the human body, heat will be gained by radiation. The amount of heat lost or gained due to radiation is directly proportional to the difference between the temperature of the body surface and the average temperature of the surroundings. It is obvious that when the average environmental temperature exceeds body temperature it is impossible to lose heat by radiation and that heat will invariably be gained from the environment.

The second method by which heat may be lost by the body is conduction. This refers to heat movement from the body either to solid objects or to the air and of these two, heat lost to the air is usually by far the greater. Once the solid object or layer of air surrounding the body is warmed to body temperature no further heat loss by conduction occurs. Heat may also be gained by conduction from the environment. If one is in contact with an object warmer than body temperature, heat will be gained. If the surrounding air is greater than body temperature, heat will also be gained from the warm air.

At this point, it is appropriate to mention the effect of convection, or air movement. It has been noted that heat is lost by the body to the surrounding air by conduction. When the layer of air immediately surrounding the body reaches body temperature, however, no further heat transfer by conduction can occur. If air currents move across the body replacing the warm air with cooler air, further heat loss by conduction can occur until the new layer of air surrounding the body once again reaches body surface temperature. If there is continual air circulation past the body a continuing loss by conduction and convection occurs. This accounts for the cooling effect of wind so common in the genesis of hypothermia. Just as wind contributes to hypothermia, it also protects against overheating. In still or stagnant air, such as found within waterproof storm gear, heat loss by conduction and convection virtually ceases.

A third method besides radiation and convection by which heat loss may occur is evaporation. Even without obvious sweating, approximately 600 ml of water evaporates from the skin and lungs daily carrying with it 12 to 18 calories per hour. In addition to this insensible evaporation, the body is capable of profuse sweating, which is a very effective means of heat dissipation. As previously mentioned, heat loss by radiation and convection may be completely blocked by high environmental temperatures where the body actually gains heat by these mechanisms from the surroundings. Under these circumstances, the only way in which the body may lose heat is through evaporation. Any factor which inhibits sweating under these circumstances permits more heat to be gained than lost by the body and allows the body temperature to rise.

There are two factors which modify the amount of heat which may be lost by evaporation. The first of these is the relative humidity of the surrounding air. When the relative humidity is low, and the surrounding air is dry, sweat evaporates readily and provides a very effective cooling mechanism. When the relative humidity is high, however, and the air is nearly saturated with water vapor, evaporation of sweat from the skin is minimal. Sweat glands continue to pour sweat onto the body surface in an attempt to cool the body through evaporation but the moisture does not evaporate because the air is already saturated with water vapor. Under these circumstances, evaporation may not occur and sweating is ineffective in promoting heat loss.

The second factor modifying the effect of evaporation on heat loss is the effect of convection or air flow across the body. The layer of air immediately surrounding the body becomes saturated with water vapor as sweating occurs. If air currents move this saturated air from the body surface replacing it with new unsaturated air, evaporation continues at a rapid rate. If air currents do not move the saturated air away from the body surface, further heat loss by evaporation ceases. This is the physiological explanation for the fact that fanning on a warm muggy day often provides a pleasant cooling effect.

In summary then, heat may be lost from the body by radiation, conduction or evaporation. Convection increases the heat losing capability of conduction and evaporation. When the environmental temperature is high, the only effective means by which heat loss may occur is through evaporation. High relative humidity and stagnant air severely diminish the ability of evaporation to promote heat loss and allow body temperature to rise.

SWEATING AS A DEFENSE AGAINST HYPERTHERMIA

Because evaporation is such an important mechanism protecting against overheating, we will now discuss a few points with regard to the sweating process. As we will see in a few minutes, sweating is controlled by the body thermostat located at the base of the brain in an area known as the hypothalamus. When the core temperature rises, sweating is promoted. In cold weather sweat production is essentially zero, but in warm weather the maximum rate of sweat production may rise to 1.5 to 4 liters per hour. During maximal sweating a person may lose from two to eight pounds of fluids per hour. When the rate of sweating is slow, small amounts of salt are lost in the sweat secretion but when the rate of sweating is high, the sodium chloride content of the sweat approaches that of blood expecially in persons unacclimatized to heat. A person who is unacclimatized to warm humid weather and who sweats profusely, may lose as much as 15 to 20 grams of sodium chloride daily. In simple terms, profuse sweating produces huge losses of salt and water each hour.

Sweating is therefore a two edged sword. It is an effective means of protecting against the rise in core temperature yet may result in loss of a great quanity of salt and water. As we shall see shortly, this will be important in the genesis of certain heat illness syndromes.

INSULATION

The human body has an effective insulating system which is important in production against both hyperthermia and hypothermia. The skin and the subcutaneous tissues, especially fat, is a heat insulator for the body: it conducts heat only 25% as well as other body tissues. The average fat layer is nearly equivalent in insulating capacity to a usual suit of clothes. The more fat, the better insulation. This insulating layer allows the body surface to approach the temperature of the surroundings, yet protects the inner core temperature.

Related to this insulating layer of the body is the so called radiator system of the body which consists of a vast network of blood vessels which penetrate the subcutaneous fatty layer. The rate of blood flow through these vessels may vary tremendously. When subjected to the stress of cold environment, blood flow from the body's core to the skin is nearly zero. When exposed to a warm environment, the blood flow may increase to nearly one-third of the total cardiac output. The high rate of blood flow from the core of the body to the skin greatly increases the loss from the surface of the body by radiation or conduction. The amount of blood flow through these vessels from the body core to the skin is governed by the degree of constriction or dilation of these blood vessels. As in the case of sweating, the degree of cutaneous blood flow is governed by the thermoregulatory center in the hypothalamus.

EFFECT OF CLOTHING

In addition to these natural insulators and radiators, clothing has an important effect on heat loss from the body. Clothing decreases heat loss

or heat gain by conduction by trapping air next to the skin and the weave of the cloth. Clothing therefore, protects against excessive heat loss to cold environments and excessive heat gain from warm environments. Clothing also may add to minimize heat loss or gain through radiation. Light colored clothing tends to reflect energy transmitted by the sun as light rays. Approximately one-third of the light waves from the sun are reflected by white surfaces, but only a small amount are reflected from dark surfaces.

Clothing is also important with regard to evaporation as we have all experienced. Clothing which is permeable to moisture allows almost normal heat loss by evaporation. When sweating occurs, the clothing may become dampened but water evaporates from the clothing thus cooling the clothing and in turn cooling the skin. Clothing which is impervious to moisture obviously does not permit cooling by evaporation.

HYPOTHALMIC CONTROL OF THERMOREGULATION

Of central importance in the control of body temperature is the temperature regulating center located in the hypothalamus. The hypothalamus is a small area near the middle of the under surface of the brain. It has many important functions, one of which is temperature regulation. Temperature receptors are located in this area. When blood flowing through the hypothalamus varies in temperature, it activates mechanisms to either increase the rate of heat loss from the body or increases heat production. When the hypothalamus is overheated, two major thermoregulatory mechanisms are activated to dissipate excessive heat. First, the hypothalamus stimulates the nerves to sweat glands to increase sweat production promoting heat loss by evaporation. Secondly, nerve signals from the hypothalamus relax tone in the skin vessels, allowing these vessels to dilate facilitating loss of heat from the skin. These mechanisms control core temperature with great precision. For example, sweating begins almost precisely at 98.4 degrees Fahrenheit, increasing rapidly as the temperature rises beyond this point. Sweating ceases any time the hypothalmic temperature falls below 98.4 degrees. Although an increase in sweating and peripheral blood vessel dilation are of special importance to us when we talk of heat illness, the hypothalamus also is capable of activating heat production mechanisms such as shivering, constriction of cutaneous blood vessels, abolition of sweating, and pilo-erection.

Through these controls the core temperature is kept within a remarkable narrow range, usually between 97 and 99 degrees Fahrenheit. A person can be exposed to temperatures as low as 55 degrees and as high as 150 degrees Fahrenheit and still maintain an almost constant internal body temperature.

SYNDROMES OF HEAT ILLNESS

The defenses against hyperthermia are both precise and durable but if thermal stress is great enough, these mechanisms can malfunction or be overwhelmed. Under these circumstances heat illness occurs.

The human body will be especially vulnerable to overheating in certain easy recognizable situations. The climber should be especially aware of the possibility of heat illness when he is climbing under these conditions. The first factor contributing to heat illness is when the environmental temperature exceeds body temperature. Under these circumstances the body gains heat by radiation and conduction. The second predisposing factor to heat illness is high relative humidity which prevents sufficient heat loss by evaporation. The third predisposing factor is absence of air circulation across the body which minimizes the effect of convection in promoting heat loss by evaporation.

HEAT EXHAUSTION

The syndrome of heat exhaustion occurs when high environmental temperatures result in extreme dilation of the skin blood vessels. Although this is a normal response to overheating, so much blood may travel to the skin that the blood supply is reduced to other vital body organs particularly the brain. A climber is especially susceptable to this problem if his body fluids have been previously depleted by vigorous sweating without adequate replacement of salt and water. Clinical manifestations of heat exhaustion are quite similar to those in which blood loss has occurred through bleeding. In other words, the patient has symptoms and signs of a low-circulating blood volume or "shock". Low circulating blood volume causes dizziness especially when the patient moves from the supine to the standing position. A rapid heart rate and cool clammy skin with perfuse sweating are characteristic. The temperature is generally not elevated. When these clinical findings occur in the characteristic setting, a diagnosis of heat exhaustion is made. Generally the climber will be unable to carry on vigorous physical activity and must lie down in order to keep from becoming lightheaded. Therapy consists of restoring adequate blood supply to vital organs by administration of salty foods, and also by raising the legs. The second critical point of therapy would be minimizing further heat exposure.

It is important to have a rough idea of how to prepare the salt solution for administration under these circumstances. An effective solution to use is known as physiologic saline and is a 0.9% solution of sodium chloride in water or 9 grams of sodium chloride in each liter of water. If one has available 500 mg of sodium chloride tablets, this would be 18 tablets in each liter of water. More diluted salt solutions often suffice. Administer salt solutions very carefully to anyone with a history of cardiac disease or high blood pressure. When enough saline solution is given, the patient will feel much better and the pulse will not increase appreciably when moving from supine to standing.

HEAT STROKE

Heat stroke or heat pyexia is a true medical emergency. It occurs when sweating and cutaneous vasodilation fail to dissipate excess body heat. The hypothalamic thermoregulatory center is overwhelmed and body temperature con-

tinues to rise in an uncontrolled fashion. Death is likely unless the patient has prompt and vigorous therapy. The clinical manifestations of heat stroke include a decrease in mental status with the patient often becoming irrational, confused and somnolent. The patient's skin is hot and dry. This provides a clue that temperature regulation has been overwhelmed since the skin should be moist with sweat in the presence of overheating. Finally, the body temperature is in excess of 105 degrees Fahrenheit. If the patient has been sweating profusely prior to the onset of heat stroke there may be findings of decreased circulating blood volume, such as the pulse changes described under heat exhaustion.

Therapy should be initiated immediately, and consists of immersing the victim in cold water or packing him in snow. This is continued until the temperature is 103 degrees Fahrenheit or less. These patients often have impaired thermoregulatory mechanisms for some time, and care must be exercised that hyperthermia or hypothermia does not occur. The victim should be evacuated as soon as possible. If snow or adequate water is not available for treatment, wet cloths should be applied to the victim's exposed skin in conjunction with rigorous fanning.

HEAT CRAMPS

Heat cramps are painful and involuntary muscle contractions usually precipitated by strenous exercise after profuse sweating. The problem is thought to arise because of salt and water imbalance in the involved muscles. The characteristic clinical manifestation is a painful and involuntarily contracted muscle. Treatment consists of replacing both water and salt in appropriate proportions. It is said that appropriate temporary relief may occur by stretching the involved muscle. The syndrome of heat cramps may occur in association with heat exhaustion.

In summary, the syndromes of heat illness occur when environmental temperature and humidity are high and physical activity is rigorous. Proper attention to salt and water consumption is usually effective in preventing these disabling conditions.

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Clothing and Equipment for Extreme Environments

by

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In an extreme cold environment there are only two solutions: increase heat supply or decrease heat loss. Man's first line of defense in the cold involves a decrease of heat loss, namely vasoconstriction to reduce the flow of blood from the deeper body areas and thus decrease the heat available at the skin for heat loss; his second line of defense is to shiver and, thus, increase his heat supply. There are limits to both physiological mechanisms, with mean weighted skin temperature much below 32 degrees C (89.5 degrees F) unacceptably cold, while shivering at a metabolic rate much above 150 kcal/hr begins to be incapacitating. Thus, clothing or auxiliary heating systems must be invoked, to supplement what biology alone cannot provide.

With regard to increasing heat supply, in addition to shivering, simply increasing the work rate can increase heat production. Climbing, which involves a great amount of physical work, and walking through deep snow, because it is very inefficient, dramatically increase heat production as most mountaineers are well aware. Increasing the weight of load carried also increases the work done, and thus the heat production, and the many layers of clothing usually worn to provide protection against the cold increase heat production linearly with each pound of clothing added. Inefficient clothing design can also increase heat production during activity; for example "the hobbling effect", in combination with the "interlayer friction" in multiple layer clothing systems increases heat production some 16%, and footwear weighing 1 kg., can increase energy cost as much as 5 kgs. carried on the torso. These approaches to increasing heat production are unintentional, are useless at rest and, since men wearing bulky, heavy protective clothing usually have too much heat produced during physical work, the physical design of inefficient clothing should be avoided and not be considered a useful approach.

The concept of increasing the man's activity level, or work rate is, of course, by far the best and if a man can be kept moving, and actively producing heat in large quantities, it is highly unlikely that he will freeze to death; however, total exhaustion, either physical, physiological or psychological may force the discontinuation of exercising heat production. Other than exercise or shivering, techniques for increasing physiological heat production are generally quite ineffective; these include increased dietary protein, non-shivering thermogenesis with cold acclimatization, and the like. Thus, if the heat supply is to be increased other than by exercise, it must be by auxiliary heat. Systems do exist which provide heat to the entire body, but these are necessarily complex and heavy and extremely expensive prototypes at present. However, the whole body generally is not a problem, except in survival situations, and a greatly extended tolerance and ability to work in the cold can be provided simply by providing auxiliary heat to the extremities. If provided from the onset of exposure, as little as three (3) watts to each hand and five (5) watts to each foot (with appropriate handwear and footwear insulation protecting these limited additional auxiliary heat inputs) has proven adequate for inactive subjects in full arctic clothing at 70 degrees F with a 10 mile per hour wind for more than 6 hours. If the heat is not provided continuously, then about double these power levels

must be provided to produce a rewarming capacity, in order to return circulatory heat input to the fingers and toes once the initial vasoconstriction has taken place. One caution with reference to such auxiliary heating of the extremities is that the reason for the effectiveness of such small amounts of heat is not the actual amount of heat provided per se but, rather the fact that the body does not shut off the circulatory heat input to the extremities from the deep body centers. Therefore, an individual given six (6) hours of tolerance under extreme cold conditions by auxiliary heat to the extremities, will experience a greater fall in deep body temperature and, if unable to rewarm by exercise or return to a warm environment, may be risking earlier total body hypothermia.

Decreased heat loss can only be accomplished by reducing convective, radiative or evaporative heat exchanges. Convective heat loss is largely a function of the thickness of the insulation. A constant relationship of rougly 4 clo per inch of material thickness is found for flat materials. With 1 clo of insulation, each square meter of skin surface loses 6.45 watts per degree C difference between skin and air temperature; with 2 clo insulation, half as much is lost, with 3 clo a third, etc. Using the relationship of 4 clo per inch of thickness, much has been accomplished in the design of cold weather clothing. However, the problem of clothing weight per se, clothing bulk and hindered mobility, and the dramatic increase in surface area for heat loss that accompanies the increased thickness of insulation around a cylinder, like the body, as opposed to insulation on a flat plate, appears to stringently limit just how much insulation can be provided, particularly to such thin human cylindrical sections as fingers. This surface area to insulation relationship explains why a mummy sleeping bag generally is warmer than a flat sleeping bag of equivalent weight, and why a mitten has to provide more insulation than a fingered glove. It also explains why sled dogs and man, sleeping in the cold, both curl up into the fetal position; i.e., to minimize the surface area presented to the environment for heat loss. Since insulation seems to have run into a block in terms of surface area and thickness relationships, attention has focused on reduction of the weight of clothing. Lightweight, nonwoven batts of material are increasingly being substituted for conventional insulating materials in parka liners, gloves and sleeping bags. However, as the density of fiber increases (i.e., interfiber air space decreases), there is a decrease in the insulation per unit of thickness, below the 4 clo per inch relationship, because of an increased radiant heat loss. In addition, attention has focused on improved outer wind proof materials, and closures, to reduce the loss in intrinsic insulation of clothing which otherwise would accompany the loss in the extrinsic, "still air surface layer" insulation as wind and/or subject movement rate increases.

Attempts have been made to overcome the increased radiant heat loss with the lightweight, nonwoven batt materials by introducing reflective insulation. However, reflective insulation is still somewhat in disrepute, since a highly publicized, reflective lining system for outercoats, although a sales success, was a scientific failure in really reducing radiant heat loss from the body. Newer techniques, which deposit reflective materials on tough, light, thin plastic materials provide a dramatic increase in insulation with little increase in weight or thickness; a "sandwich" of several layers of batt insulation, between two thin windbreak surface layers, can experience an improved insulation value, from about 3.5 clo to 5.4 clo, simply by adding 3 reflective layers of about 1 mil thickness each. There is a problem of maintaining the critical spacing required since, if the insulating batt material is compressed during fabrication into clothing, the density approaches that of conventional materials and any benefit of reflective insulation is lost.

Work is currently underway to develop practical clothing items which return the insulation value to the 4 clo per inch level, plus about 10%. The goal is retention, or a slight (10%) improvement in insulation using such multi-layer batts incorporating reflective materials, while retaining the considerable weight savings that such materials can provide.

Reflective materials generally available in the market place are impermeable to water vapor, although newer reflective materials are becoming available which retain both a high level of reflectivity and a high level of water vapor permeability. Since, at rest, about 25% of a man's total heat loss is by evaporation (roughly 1/2 from the respiratory tract and 1/2 from the skin) vapor barrier materials would be useful, if the moisture released by the body were not absorbed into the clothing. Absorption of moisture by insulating materials substitutes water, a good heat conductor, for the trapped air which is the essential element of insulating materials; as shown by Burton some years ago, whether insulation was made of steel wool or cotton wool made a much smaller difference in its insulation value than might have been expected. The "space blanket", which is a reflective, impermeable material, is primarily useful for a survival item, to wrap a casualty in, rather than for every night use since, in addition to the loss of insulation as moisture accumulates in the clothing ensemble underneath the space blanket, once the space blanket is removed all this moisture now is able to evaporate, which will result in a considerable evaporative cooling at a time when it may not be at all desirable. Vapor barrier boots have proven highly successful at slowing foot cooling rates. The current extreme cold weather boots are designed as vapor barrier systems even though moisture does accumulate within the sock gear; however, problems do arise when feet are not dried regularly and dry socks donned. The potential for use of reflective materials within such vapor barrier items seems quite promising.

A number of devices have been proposed over the years for reducing respiratory heat loss. Generally these do not seem to be worth the problems they produce, at least in healthy young individuals. Similarly, a wide variety of face masks, to reduce the exposed skin surface area, have been tested but, again, are generally not worth the trouble, given a good parka hood with a controllable aperture (adjustable wireloop) to minimize and shield exposed face surface area.

Finally, for the few individuals exposed to conditions sufficiently extreme to require such items, modern technology can provide portable life support systems which, as discussed above, provide auxiliary heat for the extremities, and can provide a comfortable microclimate within a completely encapsulating clothing system. However, such systems are complex and expensive; the usual flashlight battery, heated glove or sock commercially available in the hunting or camping stores is hardly worth the effort to carry as a survival item, even though it may extend comfort when hunting at +40 or +50 degrees F.

In summary, auxiliary heating, substitution of lightweight batt insulation, incorporation of reflective insulation where practical and, ultimately, climate controlled clothing systems are probably the solutions for extreme cold environments.

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PUTTING SURVIVAL INTO PERSPECTIVE

BY

ROBERT "SKIP" STOFFEL

There is a need to dispell traditional connotations of survival. The ability to survive is infinitely more complex than merely being able to "live off the land". Statistics prove that nearly all "survival situations" today are typically short-term in duration (72 hours or less). Preconceived ideas about survival can precipitate incorrect priorities and actions in the initial moments of stress which may lead inexorably to a fatal end. Decisions made in the first hours or minutes of an emergency have great bearing on the ultimate outcome.

It is imperative to understand the necessities of life and how they should be prioritized under emergency conditions. Traditional skills of survival have a definite place, but must be tempered with ar understanding of how the human body functions in the face of environmental, as well as mental stress. This understanding must be a product of the educational processes which ready our younger generations for places in society. The responsibility for providing this self-reliance building education lies with every individual; especially those who deal regularly with problems so often encountered when individuals are apart from civilization, i.e., search and rescue volunteers, E.M.T.'s and medical personnel doing research in mountain medicine, and responsible agencies of government.

Mountaineers, climbers, backpackers and wilderness travelers in general, often express somewhat conflicting views as to what the priorities should be in a genuine survival emergency. Who is to say what authority is right? Every incident is different just as every individual who might be involved is different. With this in mind, a brief look at the necessities of life in order of their priority should outline a general course of action.

Over the past few decades, survival has assumed a rather dogmatic connotation. Outdoor enthusiasts, the motion picture industry and private authors have all served to promote the idea that survival is something to be associated with living off the land in a wilderness setting. After analyzing many definitions, the simplest interpretation might express survival as staying alive - living a minute longer, under any circumstances, despite life-threatening occurrences. Survival must be a word used to describe any situation which poses a threat to life, whether on an individual basis or as part of a group. Survival situations are non-selective in their approach to the modern complacent citizen.

Probably the greatest obstacle that an individual will have to overcome is mental attitude. Since survival is nearly 100% psychological challenge, the brain becomes an individual's most important tool. Recognizing the body's needs and acquiring those needs will always require an initial thought process based upon previous experience and education. Under repeated stress situations, people learn to make more and more effective adjustments. By contrast, the typical emergency situation results in disorganized and frequently shock-like behavior. Unknown factors during any emergency will be numerous and variable. Some compound a situation at the same time others are counteracting it. Rational, coherent thinking will produce the most effective method that can be used in gaining control of a situation.

Modern technology has accustomed us to light switch conveniences that have eliminated thirst, hunger, cold, heat and in most cases, fear. In an unexpected survival situation, confidence and self-reliance will play a key role in determining the ultimate outcome of that experience. Unfortunately, we are not only dependent upon our technology, but we are products of a culture which has advanced beyond the necessity of being self-reliant on a daily basis. Self-reliance is developed through actual experience and dependence on one's self for the everyday needs of life. There is no substitute for actually having performed a task which is designed to save lives.

What does it actually take for a human being to stay alive on a continuing basis? A typical answer might consist of a house, a car, and three meals a day. However, it is obvious that several thousand years ago man did not have these conveniences, yet he survived. If we narrow the scope of survival to staying alive just one minute more, it is also possible to prioritize these necessities in order of importance. A thorough knowledge of these basic facts will provide a foundation of good judgment when dealing with life threatening emergencies.

In considering the basic functions of the body, one realizes that breathing is essential to maintain life on a minute-by-minute basis. Therefore, air or its life sustaining component oxygen, would occupy the first place priority on our list. The average survival time without air ranges from three to five minutes.

Inherent with a major portion of survival situations seems to be the condition of having to cope with mother nature and all of the inclement weather she can unleash. Since man is designed to live naked only in temperatures very close to that of his body, environments outside this realm post many and varied problems associated with body protection. Anything that shelters the body or protects it can be termed shelter. Clothing is shelter in close proximity to the body. The problem will be to provide adequate shelter for the environment in your situation. There are extremes in the United States where inadequate shelter could cut survival time to a few short hours. In some cases, it could even be less than one hour. With this in mind, shelter assumes the second place on the priority list of necessities for life. Fire and warmth can also be considered under shelter because by definition, they protect the body in a cold environment.

As we have already mentioned, energy levels within the body are vitally important when looking at your ability to cope with any given situation. There is a good possibility that it may not be possible to renew or add to energy levels during an emergency. Therefore, it is imperative to conserve what is present within the body. One of the most efficient ways of doing this is through adequate and prudent rest. The human body is a wonderful machine which is capable of doing many things if we provide it with proper care and maintenance. Proper and timely periods of rest in a stress situation conserves energy for future use, rids the bodies' tissues of CO_2, lactic acid and other body wastes, and most important of all, provides for a short time of reflection and analysis of our situation. Mental rest is just as important as physical rest, if not more so. Extreme stress periods of both physical and mental strain with no rest can cut survival time to as little as thirty hours. With this in mind, rest assumes the third position on our priority list.

It is generally accepted that water and its associated problems of dehydration and potable condition are among the most pressing in any survival situation. The body itself is comprised of approximately 2/3 water, which is stored within the tissues, circulatory system and internal organs. It is essential for body temperature regulation, waste elimination and digestion of food. While at rest with no activities, the body utilized approximately two quarts of water a day merely to carry on

normal body functions. Consumption amounting to anything less than this will result in gradual dehydration. Activity of any kind drastically increases the body requirements for water and serves to remind us that it is not the water that should be rationed, but the sweat and activity. A 2.5% water deficit which can occur in a few hours, can result in a 25% loss of efficiency. Extreme conditions without water could cut survival time to three days and possibly shorter if prudent methods of water conservation were not used. Without a doubt, water would have to be fourth on the list of priorities for maintaining human life.

Contrary to popular belief, the human body does not require three meals a day to remain alive. Countless people across the world today live on far less than those of us in this society. Many have only one meal a day and some not even that. Records and statistics from survival experiences show numerous accounts of forty to seventy day periods with no caloric intake. This fact coupled with current records, showing over 98% of the survival situations arising today lasting seventy-two hours or less, further serves to emphasize that procurement of survival food should be last on the list of priorities.

Energy levels within the body play an important role in warmth and performance. It is a common fact that high energy snacks provide additional calories for heat production as well as movement. Although food would play a minor role under normal circumstances, cold environments require many calories to maintain internal body temperature. As was mentioned before, conservation of the energy levels already within the body is perhaps one of the most important factors which must be kept in mind.

So far we have mentioned air, shelter, rest, water and food in what seems to be a logical order of importance. However, an often overlooked but vital priority is a mental attitude which is positive in nature and proper in its perspective for a given situation. This is usually the result of a thorough background in the knowledge and skills necessary to perserve human life in a hostile environment. If we have maintained or procured all of the other priorities on the list but lack the will to live, or the ability to cope with the situation mentally, then all is lost. We are at the mercy of the elements and whatever lady luck might perchance throw our way. The power of the human mind should never be underestimated.

It is perhaps worth a note of caution here to emphasize that although a positive mental attitude should be number one on the list of priorities, it would be possible to take negative action even though your attitude was positive. Mental attitude must not be misconstrued as a cure-all for all survival situations. Positive mental attitude (P.M.A.) does very little to analyze the body's enemies, recognize a threat to life or understand the counteractions necessary in an emergency situation. It must be coupled in the majority of cases with the proper education and background.

In order to further clarify a positive mental attitude, it is helpful to break the concept down into two categories. The first we have discussed very briefly above as the "will to live". Expressed simply, it might be described as an overwhelming urge to survive no matter what the odds or circumstances. It is debated extensively whether or not humans have a natural instinct for preservation. Numerous accounts during World War II and the Korean conflict point out the fact that death seems to be the easiest way out during periods of extreme physical and mental stress. We have the power to will ourselves to death. By the same token, we have the power to will ourselves to live. Our main focus of concern at this point deals with the problem of instilling this "will to live" throughout the majority of our society.

The second category of the positive mental attitude deals with our problem-solving ability. It is possible to be thoroughly knowledgeable, experienced, and have a positive mental attitude commensurate with the situation and still not operate at 100% of our capability. The human body operates at an optimum temperature of around 99°. Regardless of the environment temperatures, we have a relatively narrow range in which the body's core functions at peak efficiency. This also holds true for the peripheral areas of the body. For instance, in a cold environment as the body temperature begins to drop, the blood supply to the extremities is automatically reduced to conserve heat in the central core where the vital organs are located. Unfortunately, due to the reduced blood flow and lowered cell activity, electrical impulses from the peripheral areas are also reduced and very soon the brain begins to lose touch with reality. Irrational behavior coupled with reduced coordination often will precipitate a fatal accident. In the same respect heat stress, dehydration, chemical imbalances and a host of other physiological problems can drastically lower the body's operating efficiency. Knowledge, experience and mental attitude working at 100% will do no good if the body is only operating at 60%. We must safeguard our problem-solving ability with sound judgment based on a thorough understanding of indicators within the body.

What this all boils down to is this: A positive mental attitude which is proper in its perspective for a given situation ultimately assumes the highest of all priorities during any survival situation. This is a product of experience, education, and training. Shelter is the number one immediate concern in the majority of survival emergencies. The body must be protected at all costs through a combination of recognizing indicators and improvising needs. Prudent conservation of existing resources to include water, energy, and heat is also paramount to a successful survival experience.

SURVIVAL MEDICINE

BY

GENE FEAR

Survival is something few Americans think about. If they do think about it, it usually is related as someone else's problem. Few of us can relate to the problems that faced our forefathers. They had to shoulder the responsibility for sustaining life every day. The cavemen and the pioneers did not have the instant help available that we have come to expect today.

Maybe, in some ways, they were better off then we are. They lived and worked with Nature everyday. We usually face the natural elements only on weekends. We live, eat, work, sleep, play, and travel in controlled environments. They were acclimatized, hardy, and in great physical condition, with a high level of tolerance for discomfort. We are acclimatized to a controlled environment and conditioned to comfort and instant relief from thirst, hunger, boredom and discomfort. Our survival is something we not only take for granted, but we feel it is our "right."

Survival medicine is something we expect a doctor to dispense, not something we should think about or plan for. But this seminar was all about Survival Medicine. It wasn't called that, but these doctors gave each of us information about self-inflicted medical problems. If you listened, you learned how to help yourself to less misery, less discomfort, and how to live a little bit longer.

Doc Rowell explained how getting in shape would make you feel better, go farther, and live longer. Now how many of us really practice physical conditioning?

Dick Mitchell gave you advice as to what you should have with you and in your brain to cope with an accident in the back country--information that must be an automatic reflex reaction to help yourself or others.

Dr. Rynerson explained some of the mental problems to expect in remote emergencies. Mind control is really the key to getting well quicker and overcoming the unexpected emergency.

Now Peter Steele gave you some great Survival Medicine advice. He told you to "think before you drink strange water." That is really what Survival Medicine is; thinking ahead to the consequences of your actions. Peter gave you many simple solutions to minor problems of inner body management.

Dr. Bill Mills gave you additional Survival Medicine advice. He told you to "stay loose." That advice is mandatory to prevent frostbite. Get rid of tight socks, tight shoelaces, and anything that constricts the flow of body-warming blood.

Cam Bangs talked about hypothermia, which is something you can't do anything about in survival. It's too late. Survival Medicine is you taking care of you. Prevent it in the first stages, or have a buddy handy who knows how to save your life from the fast-moving, deadly effects of a low body temperature. Cam's message was, "Prevent it by proper clothing and energy management."

Dr. Drummond Rennie talked about cerebral edema. But the message you should remember was, "If you are sick from any cause, go down the mountain--not up." Now to a survivalist this makes sense. Why subject your body to greater stress and a more hostile environment when you are already weak and run down? Go down to a friendlier environment. That's survival.

Dr. Herb Hultgren gave you a message you should never forget. "Walk up, don't ride." It seems that those who ride up to high altitude (in vehicle, airplane, or sedan chair) suffer high altitude pulmonary edema more often than those who walk up. It appears that physical exertion forces the body to adjust to the altitude.

Peter Hackett spoke about high altitude sickness. His message reinforced Dr. Hultgren's. "If you must go high, go slow. Acclimatize." Peter should know. He has been researching the problems people have on the trek into Mt. Everest base camp. What he told us makes sense to me. It is Survival Medicine. Thinking ahead, managing your body, and considering the effect of the immediate environment.

Ralph Goldman's presentation on the value of body protection was great. "To manage your body in any temperature extreme, you have to have body protection with you -- and use it properly." Without it, and without proper management, you may have to practice your survival skills in shelter building.

Dr. Smith told us that we are what we eat. "Eat poor and your body is poor." In long-term survival you don't go far on roots and bark. So practice his advice and live better by eating properly everyday.

Dr. Bob Michlenburg talked about heat problems and how to cope with them. To a survivalist that is important. You are a heat producing machine, and when you work, hike, or play in a hot environment, you may be overcome with heat problems if you don't remember the good doctor's advice.

Rick LaValla just told you about the increasing problems the average Americans are creating in the back country because they don't practice Survival Medicine. Greg McDonald told you what to expect from the chopper that comes to pick you up.

All of these doctors and speakers have given you the best advice available in Survival Medicine. So my advice is to remember what they told you and to practice their preventive medicine advice. As for my contribution to Survival Medicine, I suggest you look inside you. You have the knowledge of life's experience. All you have ever learned is stored in your mind. This storehouse of knowledge is yours to be used when you have to. It supports your analytical ability to solve the problems of survival.

You also have a brain that automatically controls your body. Anything that affects you mentally will affect your body's performance. But also, anything that affects the body will affect the brain and your mind. That's why when you get cold your brain goes dumb. The same thing happens when you get too hot. The brain goes dumb. You lose muscle control. So the end result of hypothermia, hyperthermia or hypohydration is dumb brain, low performance, and collapse.

It seems that everything in Survival Medicine hinges on your ability to think properly, move muscles, and digest food. When your body is given a comfortable environment with a constant supply of the vital body fuels, it will automatically take care of itself. Our problem is that few of us have patience and good sense to listen to the body's problem indicators. Our body tells us when it needs something, or something is wrong. All too often we overrule this warning, mistake its meaning, or take medicine to mask the symptoms that are a nagging threat to our enjoyment.

Survival Medicine is managing what you have. Each of you is given 24 hours every day - 8760 hours per year - to manage your body, a mass of living cells that produce the energies of life. As long as you can manage to maintain a near constant inner body temperature of 99°, and as long as your 30 trillion living cells have the necessary fuels, a balanced chemical and circulatory system, they produce the electrical energy to run the brain and nervous system; the mechanical energy to contract muscles, and the chemical/osmotic energy that allows substances to pass through tissue walls.

Management of these vital generators of life's energies depends upon a smooth running heart and circulatory system, and the proper air exchange in breathing plus a constant supply of chemical food fuels and water.

Any change in any of these vital supply links will upset your ability to think or move muscles. The living cells hold the key to your survival. Managing them will depend upon your mental control of the input of the vital supplies they need to function or the control of the output during strenuous activity.

In survival it is you against yourself, managing what you have inside you right now -- what you have on you in the way of clothing and supplies, and whatever is around you in natural or man-made equipment.

Conserving your food and water is far better than grubbing for it from natural sources. (Of course, if good natural food is readily available, use it.) More often than not, you spend more coolant digging for water than you get from the hole in the ground. The same is true in food. You have approximately one week's supply of usable food energy in the body. So why upset your inner body with a bellyache by eating strange foods you are unaccustomed to?

Survival Medicine is thinking about the consequences of what you are about to do. Forethought is the key. See yourself a half hour, an hour, or a day from now. See yourself and feel the end results of what you are about to do. Pressing on in a storm to reach the summit; honoring a promise to get home in that foggy, wet or windy weather. Pushing on without food or water to sustain your muscle output. Hurrying up when you should go down.

Management of what you have is your responsibility. In fact, you are on your own, master of your own destiny. No one has to help you, support you, or rescue you. That's your responsibility. Many people will help you if they know you need help, and if they have extra supplies you may need. But living long enough for them to reach you and find you is your responsibility.

Only you can feel what your body needs. Only you can manage your inner body. Relying upon others to provide these needs is foolhardy. Provide your necessities. Listen to your body. Protect what you have. Think ahead of your actions. And remember all the advice expounded these past few days by these eminent doctors and outdoorsmen who have seen the end results of people who could not manage what they had and thus created a very serious problem that became a threat to life. Remember that most of our discomforts are created by what we do. Frostbite is self-inflicted; hypohydration is self-inflicted. Almost every problem talked about in the last few days is a self-inflicted problem, in most cases, and therefore is preventable.

But it is all up to you. Survival Medicine is you taking care of you - before the problem takes away you ability to think and solve the problem, or to move muscles to get you to a less hostile place.

So think ahead of your actions, and conserve and protect what you have. It may be all you will get.

CURRENT TRENDS IN SEARCH AND RESCUE MISSIONS
OR
"THE MOST SUCCESSFUL SEARCH AND RESCUE MISSION IS THE ONE THAT NEVER HAD TO HAPPEN".

BY
PATRICK (RICK) LAVALLA

Search and rescue (SAR) missions have been increasing 10 to 30% statewide over the past six years. Percentages seem to be keeping pace with the increasing numbers of recreationalists venturing away from their "greenhouse environments". Data collected and recorded by the Washington State Department of Emergency Services since 1970 indicates common factors or causes are present in the majority of missions. Analysis shows that mismanagement of the body and a lack of knowledge about internal processes resulting from environmental stress are key reasons.

Fundamentals of outdoor enjoyment for the recreationalist must include an understanding of the following:

- Body management indicators
- Environmental stress effects on the body
- Individual and leadership responsibilities when leaving civilization
- The most common factors which precipitate SAR missions

It is imperative to understand the rules and responsibilities of all factions involved in search and rescue. The state-of-the-art is advancing rapidly, but must be backed by a sound preventive search and rescue (PSAR) program for the schools and the general public.

In an effort to save lives through education, the Washington State Department of Emergency Services, Search and Rescue Division, has been recording data and statistics to find out what factors were present in each SAR mission which may have caused a problem to develop. The following list is an initial attempt to create a PSAR victim profile. Hopefully, education efforts targeting in on these factors can help to prevent future SAR missions.

Hazards contributing to survival danger:

1. Improper clothing and/or foot gear
2. Lack of rest (fatigue)
3. Thirst (hypohydration)
4. Hypothermia or hyperthermia (body temperature management)
5. Too ambitious an undertaking for current skill proficiency.
6. Poor physical condition and/or lack of motivation
7. Inadequate or improper food
8. Little or no planning
9. Inadequate party for goal; lack of leadership
10. Itinerary not known to others
11. Could not recognize a potential problem and threat physically, mentally, or environmentally
12. Weather (no preplanning)
13. Terrain (not familiar)
14. Had not anticipated a problem (It can't happen to me!)

One or more of these factors usually caused a problem to occur.

We have also concluded that our average SAR victim is a composite outdoorsman, (hunter, fisherman, skier, hiker, camper, boater, climber, etc.) He usually does not do any of these well and is not a member of related organizations. He resides in densely populated areas, travels far for seasonal recreation, has time and money, and puts too much faith in material goods and mechanical devices.

Our average victim travels too far and too fast to acclimatize, ignores signs of weather change and environmental hazards, ignores body indicators in quest of preset goals, travels from artificial environments not prepared to sustain life, and he has not learned to protect and conserve what he has.

Our modern outdoor adventurers attempt to emulate the pioneers. Unlike modern man, the pioneers' daily existence depended upon coping with weather, terrain, natural hazards, and they had no time schedule. Today's "weekend pioneer" has a crowded time schedule and, due to economic dependence to his job, often makes bad decisions in order to be back for work on Monday morning.

Most wilderness emergencies are usually solved either by the victim or outside help within 72 hours. The decisions and actions taken by the victim during the first 6 hours were the most critical, influencing the outcome.

Weather was a major factor leading to misery, causing carelessness which lead to an accident.

Evaluation of your SAR data in your state or local area can help you build a victim profile to aid in preventive education. A preventive search and rescue education curriculum outline can be developed for use for preventive programs and presentations.

In an analysis of what is needed by land management and the recreation participant, we learned that common sense and PSAR knowledge could, if used by all, alleviate the major problems. But it doesn't seem practical to try to teach common sense--either you have it or you don't. So we looked farther. We analyzed outdoorsmen who, we felt, had common sense (people accepted by land management as good outdoorsmen, experienced, reliable, and protective of the lands they travel). After much research we found that people with outdoor common sense have certain things in common:

1. They understand the priorities of life and survival
2. They can recognize and analyze body problem indicators
3. They can recognize a danger problem developing
4. All are curious, inquisitive, alert, confident, and search for information
5. They can apply sound judgment to time and environmental problems
6. They are decisive after analysis of the problem or threat
7. They enjoy a mental or physical challenge
8. All are seemingly non-destructive of material things
9. Most are do-it-yourselfers, and work well alone

When we look at this list of basic human attributes, we find that many of these qualities are absent in those people adjudged to be the problem makers for outdoor recreation land managers. Furthermore, we found that those experienced outdoorsmen we analyzed, had to acquire extra knowledge in five categories, either by reading, practicing, or taking courses. These are the categories of knowledge which can be taught to bolster self-confidence in providing for and protecting life away from civilization:

1. Self First Aid - Knowledge of immediate first aid to self and others.

2. Survival Knowledge - How to protect and provide the necessities of life long enough to get back home.

3. Navigation - Knowledge of how to determine one's exact position on earth in relation to home, car, or civilization.

4. Hiking - They learned, practiced and perfected good techniques of eating, sleeping, and traveling in all terrain and environment.

5. Recreation Sports - They acquired specific knowledge, practiced safe techniques in the use of special recreation-related equipment (skis, snowshoes, ice axes, ropes, guns, vehicles, etc.).

If good outdoorsmen admittedly acquired these five kinds of knowledge at their own expense of time and energy to become better prepared, then these should become the basis for an educational effort to thwart the necessity for excessive, restrictive regulations.

Now that we know what education is needed, let's determine who needs it. We must recognize that we have three different groups of recreation travelers. Each group requires a different type of program to provide them with the basic information they need. These are:

Today's Traveler	- He's Gone
Tomorrow's Traveler	- He's Planning To Go
The Future Traveler	- He's Hoping They Will Let Him Go

Today's Traveler has left for the field. We are too late to reach him with education. Any educational help he gets will be from the land agency he visits - via signs, literature, and verbal contacts.

Tomorrow's Traveler may or may not take time to read, plan and prepare for his trip. The best effort here will be visual aids, literature, books, lectures, and specific adult courses that teach recreationists the basics of eating, sleeping, and traveling away from our society's modern technology.

The Future Traveler can be reached via the regular learning channels, providing all of the schools offer good basic education at the receptive age. The basic subjects necessary for travel away from civilization are also useful every day by every person within civilization. The difference is that modern technology makes it easier.

Everyone must learn or depend upon someone to provide the simple first aid, survival, and navigation needed just to live and travel in our modern society. It would be extremely helpful in daily life if these basic subjects were taught to all rather than leaving them to the trial and error learning method used now. If all respectable outdoor oriented organizations would agree on the educational subjects needed, their priority of importance, and would support the program within the school system, it will be possible to save lives through education.

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COMPLETE CARE OF THE ACCIDENT VICTIM

Cameron Bangs, M.D.

Introduction

An injury is always accompanied by an emotional shock greatly influencing the victim's future. People never completely forget even a simple accident like hitting a thumb with a hammer—especially when using the hammer again. Emotional changes after severe injuries play an important role in the victim's response and rehabilitation.

To rid a child of his fear of the dark, one must understand what it is about the dark that frightens him. Similarly, to ease the fears and anxieties of an injured victim, one must try to understand them. The care of an accident victim may be ineffective without an appreciation of the psychological trauma accompanying the accident. Such an appreciation comes only with effort.

1. Emotions of the Victim

A. Loss of self-esteem

After an accident, the victim suddenly loses self-respect. The ego diminishes, and inferiority feelings appear. In an epidemiological study of skiing injuries, the victims rated their skiing ability in the morning and again after injury had occurred. After an injury, the self-image of the skier dropped.

Almost all injuries involve errors in judgment, and frequently the immediate reaction is self-blame. If there are also injuries to others, guilt develops and further lowers self-esteem.

B. Embarrassment

Injured people are often embarrassed. Because the accidents were probably their own fault, they feel stupid. In most accidents, victims react to pain and panic by crying or yelling. Afterward they feel embarrassed by this emotional exhibition. If the accidents involved selfish actions of self-protection, the victims feel doubly embarrassed.

C. Loss of independence

After an accident, the victim becomes dependent upon the rescuer for care and even survival. Nobody likes losing his self-reliance and becoming a burden to other people.

D. Fear

The injured victim may have many specific fears:

(1) Fear about the possible extent of the injury.
(2) Fear about the quality of care. A victim may worry that a first aider is unskilled. Improper care could make the injury worse.
(3) Fear for the immediate future. It is said that when a child is hurt while skiing, he worries mostly about what his parents will think; when a high school or college person is injured, he worries about how soon he can ski again, and when a breadwinning adult is injured, he worries about his job. There are many things to worry about right after an accident, including transportation, notification of family or friends, and the return to a normal existence.
(4) Condition of other people hurt in the accident.

E. Personality changes

Sick or injured people consider their own health the most important matter in life. They have little or no interest in anything else. Other factors, like pain, hypothermia, shock, or head injuries, may also influence behavior.

II. How to Give Complete Care

To give complete care, one must try to understand the victim's anxieties and handle him accordingly.

A. Insuring Quality of Care

(1) If at all possible, before handling the injury, spend a brief period establishing a relationship with the victim. Relate to him as a person, not just as a broken body.
(2) Identify yourself. The victim will be relieved to know who is caring for him and what your qualifications are. Try to describe your training briefly.
(3) Nothing is more reassuring to a victim than strong leadership and orderly treatment. Be sure that one person is in charge and respect his decisions. Intelligent discussion is reassuring, but pointless bickering is not. In front of the victim, never criticize care administered by another person.
(4) Remain calm and deliberate. If you are agitated, the victim will be also. Hysteria is contagious. Force yourself to slow down and talk evenly.
(5) Warn the victim of pain. Many treatments necessarily cause increased discomfort. If the victim is warned ahead of time, he will feel confidence and trust. Do not touch a tender spot suddenly. Never say, "This won't hurt," when you and the victim both know that it will.
(6) Be honest. A victim will not be reassured by an attempt to hide something. Discreetly explain the extent of the injury.
(7) Give thorough and complete care. Do not hurry, and if there is time to spare, keep repeating your examination.
(8) Keep the victim comfortable and warm. Make sure that he is neither hungry nor thirsty, and that he does not need to urinate.

B. Restoring dignity

(1) Use the victim's name. He will like the sound.
(2) Treat the victim with respect, as if it were a pleasure to serve him. Never make him feel like a burden.

(3) Remain concerned. It is easy to care about a victim during the drama of initial treatment. But during a long evacuation or a stay in a first aid facility, other interests may overshadow your sympathy. Remember that it is nice to have someone check up on you a day or so after an accident.

(4) Decrease the patient's loss of independence by involving him in his own care. Let him hold dressings, run the radio, or assist in lifting and moving. Consult him about decisions. Keep him informed and involved during the entire event.

(5) Never reprimand or moralize about errors.

(6) Allow the victim to discuss the accident. During World War II, British victims of bombing suffered less residual psychological trauma if they discussed what had happened immediately afterward. A victim should be encouraged to talk about the accident.

III. Victim Education

A. Overall outline

The anxieties of treatment will be diminished if the victim knows what is going to happen. Before beginning, give the victim an overview of "what, how, and when." Discuss evacuation and transportation as well as treatment.

B. Lifting the victim

Of all emergency care by nonprofessionals, lifting is probably done most poorly. One of the reasons is failure to coordinate the lifting with the patient. Unless the patient is prepared properly, he will either resist or try to help. Thus he makes the lifting more difficult and causes himself discomfort. Before lifting, mention how it will occur and what you expect the victim to do.

C. Information regarding other people

When there are many accident victims, each is concerned about the condition of the others. Whenever possible, they should be told the extent of each other's injuries. At times discretion is needed, but usually honest discussion works best. Injured people are frequently concerned about family or friends at home. Reassure victims that these people will be contacted.

IV. How to Learn to Give Complete Care

A. The ability to handle an injured victim is learned by conscious, disciplined effort.

B. After an accident, go over a mental or written checklist to be sure you included everything. For example, did you ask the victim's name? Introduce yourself? Do a complete exam? Did you warn him before you caused pain? Offer to locate companions? Let him discuss the accident? Is the victim cold?

C. Many useful techniques can be learned by watching the practice of first aid. If your help is not needed, stand back and observe.

D. Stage a simulated injury and practice giving complete care. Such a rehearsal can be arranged at home with as few as two people, or in large groups with everyone offering constructive criticism. You should emphasize complete care rather than just techniques of splinting or bandaging.

RESCUE

Dick Mitchell

Two-thirds of all mountaineering accidents involve people with little or no mountaineering experience. Most accidents occur on rock, rather than snow, but probably because people climb usually when there is no snow. Less than 10% of all accidents are caused by avalanches, medical illnesses, improper rappels, or malfunctioning equipment. Most accidents occur when hikers fall or slip. In nearly all cases, neglect, lack of technical knowledge or common sense, and physical or mental fatigue are precipitating factors.

In the Pacific Northwest, most mountain rescue groups use cable systems for lowering and raising victims. These systems require special lowering blocks, cable grips or come-alongs, and mechanical, hydraulic, or gasoline-powered winches. By contrast, Yosemite National Park uses rope from 600 to 2000 feet long for rappels and raises. In this way, standard climbing equipment can be used without specialized training and techniques. Rescuers everywhere are relying more and more on helicopter evacuation.

In the Pacific Northwest, a call for rescue must come via a responsible agency, such as a sheriff or the National Park Service. This agency notifies a central contact, which notifies a call committee, which notifies the members. Usually there is an In-Town Operations Leader (OL), a Base OL (who mans the truck), a Field OL, a Team Leader (when required), and a Medic. It is up to these people to get a rescue mission together. The victim is not charged for any of the services of the Council unless a private helicopter is used. Nationwide, however, more and more rescue groups charge for services rendered.

Education by brochures, books, films, and seminars is the primary means of preventing accidents. Although groups and organizations are eager to educate, they require financing. The state, the army, insurance companies, and schools sometimes provide money. Reliance on public service announcements for safety education has not been satisfactory.

Hikers faced with an accident often make mistakes. Here are some of the most common:

(1) The first aiders are too slow. The victim bleeds to death while they take off their packs and decide who should stop the bleeding.
(2) They become confused or upset by the blood.
(3) The first aiders forget the correct sequence of responses to the accident.
(4) The examination is incomplete, and not all injuries are found. The first aiders do not take enough time for diagnosis.
(5) A victim with a suspected fracture is moved unnecessarily before splinting. (Never allow movement before splinting unless weather or terrain threaten life or splinting in the original position is impossible.)
(6) The party does not go beyond immediate first aid for the victim. (Always consider the following: evacuation, shelter, food, searches for help, stretchers, the well-being of the rest of the party, and a landing area for a helicopter.)
(7) Most of the hikers stand around and ignore secondary chores.
(8) No one talks to the accident victim. (Ask where he hurts, if he is comfortable, if his bandages are too tight, how the accident occurred, if he takes regular medication, or if he is thirsty. Tell him what the first aiders are doing.)
(9) No one listens to the accident victim. His complaints of cold or a specific pain get lost in the confusion.
(10) The party fails to follow through completely on the victim's needs. When he complains of cold, he gets covered, but not insulated from the ground.
(11) In the presence of the victim, the first aiders discuss his condition or debate his future. Thus they give him unnecessary anxieties.
(12) Splints and bandages are too loose to do the victim any good.

The only way to eliminate these common mistakes is to practice under realistic conditions. Constructive criticism will develop the correct response eventually.

EARLY RECOGNITION AND TREATMENT OF COLD INJURIES

Cameron Bangs, M.D.

Introduction

When dealing with cold injuries, as in many areas of mountain medicine, the ultimate outcome frequently depends on proper early recognition and treatment. Frostbite may cause loss of extremities! Hypothermia may cause loss of life! Skillful early care may alter these tragic outcomes. This discussion deals only with chronic hypothermia, not sudden immersion in cold water.

Recognizing Hypothermia

Even marked hypothermia may be difficult to recognize because the victim may appear normal to the cursory observer. There is an old adage in medicine that "if one doesn't think about rare diseases, they become more rare." Although hypothermia is not rare, the adage is applicable because one must discipline oneself to think of hypothermia in the cold, wet environment.

Taking the victim's temperature with a thermometer is extremely important. Oral temperatures are acceptable (except to the physiologist). Rectal temperatures are slightly more accurate but considerably more difficult to obtain. Axillary temperatures are virtually useless. Remember that clinical thermometers are not made to record low temperatures and special thermometers or thermocouples are needed. An easy technique for recognizing impending metabolic bankruptcy (due to hypothermia, starvation, diabetic acidosis) is to note the acetone odor of the breath. The odor has a peculiar sweetness to it very similar to acetone (airplane glue) which, once smelled, is never forgotten.

The changes of hypothermia can be listed under the general categories of mental changes, muscular changes, and changes in vital signs.

Mental Changes

A good rule of thumb is to divide hypothermic victims into those with impaired levels of mental function (severe cases) and those with normal levels of mental function (less severe cases). The impaired mental function may be further divided into:

1) Difficult to recognize (you have to think about them).

2) Easy to recognize (they jump out at you).

Difficult to recognize mental changes: When the core temperature drops a few degrees (2° to 4°C.) the mental changes are subtle and may be interpreted as simply a change of

attitude. The victim drops out of the conversation, becomes slightly withdrawn, introverted, and perhaps discouraged or mildly depressed. There is loss of enthusiasm for simple tasks, the environment, and one's companions. With a few more degrees' drop (4° to 8°C.) the mental changes become more pronounced. There develops an inability to concentrate, indecisiveness, some confusion and perhaps disorientation. Decisionmaking at this point is perilous. Important, life-threatening decisions may be incorrectly made but dangerously and convincingly transmitted to others.

Easy to recognize symptoms. When the core temperature reaches 26°C. to 30°C. (80°-86°F.) the mental changes are obvious. There is definite sleepiness, lethargy, depression and confusion. There may develop irritability, combativeness and refusal of care. These changes may wax and wane in 5- to 20-minute cycles with lengthening periods of despair as the temperature drops. Ultimately there is complete unresponsive coma, simulating a death-like state, which may precede actual death by several hours or days.

Vital Signs

Carefui observation and recording of vital signs, both initially and during transportation and treatment, are important. The temperature, of course, is decreased, the pulse, blood pressure and respiration are similarly depressed, but unless specifically measured, the changes may go unnoticed.

Pulse may be weak, as well as slow, and when hard to feel at a rate of only 20/minute, can be overlooked and tragically interpreted as absent. Blood pressure is reduced, and because of slow pulse may also be incorrectly recorded. The respirations may be reduced in both rate and depth to almost negligible levels.

Muscular Changes

Similarly, changes in muscular function are at first subtle, proceeding to obvious and profound. Initially, as temperature drops, there develops a slowness of function, seeming stiffness of extremities and a heavy feeling. Fine coordinated tasks (using zippers, tying knots) become difficult. Walking becomes unpleasant and labored. These early muscular changes, coupled with an apathetic attitude, lead to carelessness so that important tasks such as zipping a parka may be left half done.

With decreasing temperature, the uncoordination increases, leading to staggering, stumbling, and falling until one is unable to care for oneself. At very low core temperatures, usually associated with complete coma, the muscles become stiff and simulate rigor mortis.

Early Recognition of Frostbite

Most outdoor people are familiar with the classic changes of frostbite: the swelling, dramatic blisters and black eschar. Many fail to realize that these are the late changes (1-7 days) and that even severe frostbite may appear normal while still in the frozen state. To avoid costly mistakes in the early treatment of frostbite, always assume it has occurred to all four extremities if severe environmental conditions have been present.

Description of Early Frostbite

The extremity may, if completely frozen, feel hard and woody. With lesser degrees of freezing, the texture varies between normal and hard. Usually the outer surface is the most frozen and hardest. However, if some thawing has occurred, the extremity may feel normal superficially but hard within, like a half-thawed steak.

The color may vary from normal to pale. It may be a deep red or light to dark

purple. There may be no blanching of color when pressure is applied. After thawing, if redness appears, it may blanch with pressure from the examining finger, but the color will return very slowly after releasing the pressure. (Compare this to one's own extremity.)

Particularly, if several days old, there may be swelling (recognized by tightness of the skin), clear or blood-filled blisters, both intact and broken, with some disruption of the skin.

The most inconsistent and therefore unreliable symptom is pain. Most victims will complain of numbness and loss of sensation or a "club-like feeling." The pain may vary from none at all to very severe and burning. Some have described loss of pain as the extremity freezes and return of pain with thawing.

TREATMENT

Hypothermia

Because of the multiple and varied factors involved in any case of hypothermia (e.g., patient's condition, treatment available, transportation, and weather), there is no single simple equation to combine the patient with the best treatment. Only general guidelines can be provided which must be adapted for each individual case.

I. Rewarm the victim only when it can be done properly.

Under most circumstances, the chronic hypothermic victim has been exposed for 12 hours or longer and a few more minutes or hours will not be life-threatening. The most dangerous period in hypothermia is during the initial rewarming. If at all possible, the victim should not be rewarmed until he can be evacuated to a hospital or to a safe environment where he can be rewarmed properly with adequate monitoring, equipment, and medicine to deal with life-threatening complications.

II. Handle the victim gently.

With severe hypothermia, there is danger of death due to ventricular fibrillation. The "cold, cold heart" is vulnerable to ventricular fibrillation, which may be triggered by shaking, jarring or bouncing. If there is any pulse, even though very slow, cardiac massage should be avoided as this too may cause ventricular fibrillation.

III. Prevent further heat losses.

Even though it may be ill advised to start rewarming, there is no reason to allow further cooling. The victim should be put into dry clothes, protected from the wind and conductive heat loss. If transporting by vehicle, the temperature may be kept comfortable, but below the victim's core temperature, without danger.

IV. In the field *do not* rewarm too fast.

The rate at which the victim should be rewarmed is probably the most controversial and confusing aspect of cold injuries. Part of this controversy stems from failure to separate hypothermia into acute (immersion), subacute, and chronic (exposure), as well as by failure to treat mild and severe hypothermia differently. In the hospital, where all modalities may be monitored and treated, rapid rewarming is currently in vogue. In the field, if rewarming has to be done, it is probably safest to do it slowly. Slowly means most anything *except* submerging the victim in hot water. Rapid rewarming can lead to blood vessel dilation and shock and is discouraged.

V. Rewarm the core first.

When the rewarming starts, blood is shunted from the warmer core to the cold

periphery. Cold peripheral blood with its faulty metabolites is returned to the core. This causes a paradoxical deterioration of the core after rewarming has started, so the temperature lowers and acidosis worsens.

The core is rewarmed by giving hot liquids by mouth (if conscious), applying external heat (hot water bottles) to the trunk (abdomen and chest) rather than to the extremities. In a hospital, give hot IV fluids or heated peritoneal dialysate.

Heated air or O_2 will add only a very small amount of heat to the core, and the gas must be 100% humidified or evaporation in the respiratory tract will cost the body heat.

VI. Hypothermia is life-threatening so treatment takes precedence to non life-threatening problems.

There is a priority list for all early care. For example, breathing problems and blood loss may cause death quickly and should be given early priority therapy. It must be remembered that frostbite, fractures and most other injuries are not as life-threatening as severe hypothermia, therefore the treatment for hypothermia should not be compromised because of other conditions. Under most circumstances, fortunately, other injuries can be treated without risk to the patient.

VII. Ventilation assistance.

Under all conditions an adequate airway must be maintained; hypothermia poses no special problems here. Severe hypothermia victims are underventilated and will benefit from supplemental O_2 or positive mouth-to-mouth pressure ventilation.

VIII. Core temperature needs to be maintained after rewarming.

Hypothermia damages both the central thermostat (hypothalamus) and the peripheral mechanisms to prevent heat loss (vasoconstriction, perspiration) for a long time, often over three years. After the victim has been rewarmed, his temperature must continue to be monitored because the core temperature may drop again. All effort should be made to prevent re-exposure to the elements.

IX. Complete care.

Don't allow the drama of hypothermia and frostbite to cause other injuries to be overlooked. Thorough examination and care is a must, because cold victims do not tolerate other injuries well.

X. Use of advanced life support.

With the increasing use of mobile coronary care units, manned by paramedical personnel (EMT III's), there may be available, in the field, advanced life support. When this is available, the following information should be considered.

A. *Cardiac monitoring*
Death from hypothermia is due to cardiac catastrophe. Ventricular fibrillation is the most common cause of death, with cardiac standstill being second. Cardiac monitoring is therefore of value.

B. *Intravenous therapy*
Hypotensive shock is in part alleviated by intravenous volume expansion with intravenous fluids such as Lactated Ringer's, saline or bicarbonate. These should never be given when the solutions are below room temperature; they should preferably be heated to 45° (100-110°F.).

C. *Acidosis*
The major metabolic derangement is acidosis. This is improved by the administration of sodium bicarbonate.

D. *Lidocaine*
The ventricular irritability may improve with Lidocaine. This drug has been shown to be safe for use in hypothermia.

E. *Electric defibrillation*
A fibrillating heart will not convert to normal sinus rhythm until rewarmed.

F. *Morphine, Epinephrine, sedatives, stimulants, Isuprel and Atropine*
These drugs are believed dangerous to a hypothermic victim and should be used very cautiously, if at all.

EARLY TREATMENT OF FROSTBITE

General

As with hypothermia, there are many variables to any case of frostbite. The following five guidelines should, if combined with common sense and improvisation, provide proper treatment.

I. Never thaw improperly.

Most tissue damage from frostbite occurs during the freezing and thawing period, or after thawing, inadequate blood flow. While frozen, the damage to the extremity occurs very slowly over many hours or days. For this reason there is no reason to jeopardize the life of the victim to thaw the limb a few hours earlier. Frostbitten feet are not greatly damaged by walking on them; thawed feet are. Frostbite, therefore, should never be improperly thawed when proper treatment lies a few hours away. The safety of the rescue party should never be jeopardized by having to carry a victim out when he could have walked if left frozen.

II. It is best to overtreat.

Too often, failure to rapid-thaw an extremity has occurred because frostbite was not recognized early. For this reason, all four extremities should be rapidly thawed for anyone with even minimal exposure. There is rarely harm done by treating unnecessarily.

III. Thaw rapidly.

There is no question that the best early treatment for frostbite is to thaw in large vessels of water at 45°C. (110°F.) for 30 to 45 minutes. The extremity should be kept cold with no thawing, until this can be done. If there is unavoidable delay, the extremity should not be kept colder than freezing as this might increase the cold damage. Never thaw with open flame or direct heat.

IV. Technique of thawing.

a) Equipment needed
   1) Large vessels (3-10 gallon) for water
      These are frequently available from lodge kitchens, gas cans, etc. One for each extremity is desirable, but both feet may be thawed in one large vessel.
   2) Thermometer
      Water temperature can be regulated much more accurately with thermometers, preferably one for each vessel. If thermometers are unavailable, water temperature of 45°C. (110°F.) may be estimated by realizing that it is so hot that one can just barely stand to keep hands submerged.
   3) Pitchers and bailers
      The vessels will have to be periodically bailed and refilled to maintain adequate temperature.

4) Mops
Order must be maintained and chaos avoided. Water on the floor leads to slipping and chaos.

b) Position
It is impossible to lie flat and submerge hands and feet properly in water. The best position is to place a stretcher or a long board across the bed and have the victim sit on this and lean against the wall. The hand vessels may then be placed on the cross beam and the foot vessels upon the cot.

c) Leadership
The procedure is best carried out when one person acts as supervisor with each extremity assigned an attendant who maintains the thawing process until completed.

d) Technique
The extremity is submerged in the water bath and floated freely without cramming against the vessel wall. The water is circulated manually, by stirring. Hotter water is added as the temperature of the water bath drops below 45°C. (110°F.). Do not pour hotter water directly on the extremity.

V. Protect the extremity.

After thawing, the extremity should be treated very delicately; do not rub to dry, blot if necessary. Place cotton between the toes and wrap extremities with fluffy, bulky dressings. Protect the entire extremity with splints but *NEVER* cause constriction to blood flow with tight wraps of any kind. *NEVER* allow the patient to step on feet or use hands after thawing.

FOOD AND SURVIVAL

Jean A. Syrotuck

Because they know they are going to remote areas for long periods, persons planning an expedition usually pay attention to the details of food and survival. But not so with recreational hikers, climbers, and picnickers, out to enjoy themselves for a day or two. Many of these are adults in the prime of life who should be best able to deal with adverse conditions. However, because of a lack of planning, inattention to detail, or just ignorance, they sometimes end up in trouble. Their rescuers are frequently placed in high risk situations of bad weather, long hours, and difficult terrain. Like the hikers, the rescuers should learn to recognize hazards and take preventive measures. There has been considerable research into the factors affecting our ability to survive.

Accidents

Most accidents are not acts of God. Epidemiologists' studies show that many accidents are predictable. Possible tasks vary from the simple (or well-learned) to the difficult (or unlearned). But each person's ability fluctuates with time and circumstance. When a person encounters a complex task at a time of low operating efficiency, the likelihood of an accident is high. The very young, the aged, and the unskilled run the greatest risk because their motor skills and responses are less dependable. Sometimes the difficulty of a task is not obvious. For example, a rock climber on a sheer 100-ft wall is prepared for a complex situation. But an old man wandering on a logging road in late spring may discover suddenly that his situation is too complex for his health and capabilities. The elderly, the young, and the medically disadvantaged can still enjoy the out-of-doors. But they must be aware of their limitations and keep within safe bounds.

Nutrition

Acimdoldos's 16th century painting arranges various foods to depict the head and shoulders of a man. The resultant suggestion that "we are what we eat" is a fact of life. But many affluent Americans are malnourished because of willfully poor eating patterns. Overeating leads to obesity and medical derangements.

Many factors affect eating habits. Social factors may either keep us from eating balanced meals regularly or, on the other hand, oblige us to eat more than we wish. Among young people, dietary fads often produce sub-standard nutrition. Family attitudes also dictate meal patterns. Food attitudes of the father greatly influence what is served at meals, and a mother's nutritional ingenuity (if she has any) can be taxed by the different tastes of a finicky family. If the children do not grasp the importance of nutrition, they will be unable, as adults, to transfer good attitudes to *their* children. Finally, ethnic factors play an

important role. Tradition affects our preferences, and taboos may severely limit the exploration of new foods. Many semi-starving societies have available in nature certain foods never utilized for cultural reasons.

There are many issues of nutrition yet to be clarified. The minimum daily requirement merely prevents deficiencies. But what are the optimal amounts, and how do these change in different circumstances? The multiple roles of trace elements are just now coming to light. How do they interact in the body systems? It is now known that prenatal nutrition affects both the growth capacity and learning ability of children. But how can we motivate adults with poor habits to make good use of this information?

Fortunately, the human body has a remarkable tolerance of malnutrition under controlled circumstances. The person who swills a cup of coffee in lieu of a proper breakfast may show no problems for a long while. But if this same person requires emergency surgery, capsizes in a boat, gets stuck in a stalled chair lift, or becomes snowbound in a traffic jam, his lack of attention to calories and nutrition may carry a severe penalty.

Biorhythms

Why should an experienced, well-equipped leader die on a familiar outing with a party of fifteen people? One contributing factor could well be biorhythms. There is a growing interest in this rather old subject. The best understood rhythms at present are the circadian (or 24-hr) cycles involving daily secretion of hormones, activity of enzymes, and metabolism of different nutrients. Some functions occur during sleep, others during waking hours. There is even some variation between the right half and the left half of the body. Jet lag results when we try to carry out external functions that no longer match our internal clock. We may require several days or several weeks to adjust.

Another example of biorhythms is the contrast between nocturnal people ("night owls") and diurnal people ("early birds"). The peaks of their performance and activity may differ by 8 hours or more. This contrast explains some incompatibility in marriage and other joint endeavors.

There are longer rhythms of 1 month to 3 months which are less well understood. The cycles of these longer rhythms (there are probably three major ones) are not synchronized. Substantial changes in abilities and functions are thought to occur at various points of intersection or synchrony.

Despite the lack of definition in this subject, a person can develop an awareness of his own functions. Sensing that he is functioning at a low level, he should refrain from undertaking arduous trips. Recent illnesses, tension, or lack of sleep should serve as additional danger signals.

Phenotypes

Body build has a definite effect on response to environmental stress. The tall, skinny person has a large ratio of surface area to body mass. Thus he is capable of losing heat quite efficiently when sweating. By the same token, he has a greater risk of cooling excessively in cold weather or cold water. Short, square persons experience the reverse situation. They resist great cooling, but risk overheating in hot environments.

Obesity poses additional problems. A fat hiker is like a short, square person carrying a 30-lb pack. Such a hiker's energy needs and heat production are much greater than those of the non-obese. To compound matters, fat people are usually in poor physical condition, and so their work efficiency decreases still further. Hikers can prevent many problems by diagnosing their phenotype and then planning their clothing and activity accordingly.

Stress

Since prehistoric times, man has had a well-developed response to a physical stress or threat. An adrenalin sensation of "flight or fight" is effective when we can respond physically. Today, however, many forms of stress are imposed by situations in which a physical response is taboo. It is not generally acceptable to poke a boss in the nose. The natural adrenalin response must be suppressed, to the detriment of many body systems. Mental harassment and hectic schedules take their toll in this fashion.

Dr. Holmes at the University of Washington has assigned stress points to various events of life. Marriage, death, and divorce receive many points, but arguments, colds, and new puppies receive fewer. Holmes can often predict when persons will fall prey to a major illness or accident. Whenever they accumulate an excess of points, whether for happy or sad occasions, the surplus stress puts them in danger. Persons planning major expeditions will be susceptible to mishaps if their plans coincide with important changes in life.

Some recent research suggests that stress, depression, and a sense of helplessness may be due to a depletion of neurotransmitters. Nutritional factors may also be involved.

Physical Conditioning

Many books and articles extoll the benefits of exercise. The human body was designed for more physical activity than our society practices. The poorly conditioned waste some 15% of their usable energy.

Dr. Pugh studied some Welsh "hillwalkers" on a trip of 28 miles. He found that "fast" walkers adjusted their pace and clothing to maintain a comfortable level of heat production without becoming very tired. But "slow" hikers tended to vary their pace a great deal, becoming overheated with excess exertion and then chilled when traveling slowly to recuperate. Thus "slow" walkers had to push themselves too hard in order to maintain a comfortable body temperature. Collapse from exhaustion became a possibility in about three hours, and death in about five.

In cold environments, the normal reaction of the circulatory system, as a means of conserving heat, is the constriction of peripheral blood vessels in the arms and legs. In a state of exhuastion, such peripheral vaso-constriction is impaired, and so the exhausted person cools much more rapidly. When exhausted, people have used all readily available fuel and are no longer capable of physical exertion or heat production. The body produces optimal amounts of energy and heat according to the following simplified formula:

$$\text{Glucose} + \text{Fat} \xrightarrow{O_2} \begin{matrix}\text{energy} \\ \text{heat}\end{matrix} + CO_2 + H_2O$$

One of the earliest symptoms of exhaustion is ketosis. Sub-optimal amounts of energy and heat are produced in this way:

$$\begin{matrix}\text{Fat alone or} \\ \text{Glucose} + \text{Fat}\end{matrix} \xrightarrow{O_2} \begin{matrix}\text{energy} + \text{ketones} \\ \text{heat}\end{matrix}$$

Ketones are easily detectable on the breath. Anyone suspected of overexertion or exhaustion, anyone seeming vague, clumsy, or irritable should be checked for a fruity breath.

Exhaustion can become lethal very quickly. One 25-yr-old man, after a late night, with only a donut and coffee for breakfast, no lunch, and no snacks, decided to go hunting about 3 P.M. As his automobile came over a ridge, some game appeared across the road ahead. The young man leaped out of the car, pursued down the hill through knee-deep snow into a valley where he had hunted for ten years. As darkness fell, his companion heard many

shots and realized that they were distress shots. The young man could not pick out landmarks in the dark fog. The companion signaled, but replies were first nearer, then farther. Finally at midnight he left two chance strangers with a beacon fire and went for help. Early next morning the young hunter was found dead, less than ¼ mile from the beacon fire. He had been dead for many hours.

The single cause of death was hypothermia due to exhaustion. The young man was reasonably dressed for the weather, and had both the materials and the skills to build a shelter. He may even have had a source of food from his downed game. Instead he continued his struggle through knee-deep snow, one of the most exhausting activities imaginable.

Calories, Water, and Salts

A balance of these three essentials helps prevent exhaustion. Intake must equal or exceed energy output.

	Calories	*Water*
Normalcy	3000 per day	2 quarts per day
Rest	60 per hour	
Strenuous Exercise	600 per hour	4-8 quarts per day
Severe Exercise	900 per hour	1 quart per hour or more

The "hillwalkers" in Pugh's study traveled 28 miles in 9 hours. Such a walk requires 5,700 calories and about 6 quarts of water. There was no indication that the walkers consumed anything near this amount. Thus it is no surprise that many casualties occurred.

People lose salts via sweat in cool weather as well as hot. This process can cause cramps in the large leg muscles. Progressive salt depletion over a 3-day period can create a kind of heat exhaustion unrecognized as such because of the cool weather.

Being in good physical condition helps in conserving energy, salt, and water. By working more efficiently, the body suffers less waste per job in both hot and cold environments. In heat, water balance is always a major concern. Moreover, salt is lost via sweat until acclimatization occurs. In acclimatization, the pulse rate and internal temperature stay within normal range.

One of the most practical ways to conserve calories, water, and salts is to reduce the work load. Set a reasonable pace. Recognize that people vary in their capacities for work, and distribute the work load according to these capacities. The stronger members will be able to set a slower pace with an extra load, and the weaker members will not be pushed to exhaustion trying to keep up. In a survival situation or in severe weather, this pattern could provide the difference between life and death.

Survival Clothing

Special photographic techniques reveal a thin layer of moving air as part of the body's microenvironment. These currents of warm air start at the feet and flow up the surface of the body, finally off the top of the head in a 3-ft plume. Since air is a poor conductor, this layer serves as a first defense.

There are only a few areas of the world where man can live naked. Thus, clothing and shelter must preserve the microenvironment next to the skin, keeping it from becoming too hot, too cold, or too wet. Water displaces the air layer, and so water chills the body very quickly. Wind can whip away the microenvironment. This fact accounts for the chill factor of wind in cold weather. In cold, wet weather, the wind chill combines with water displacement of the air layer, and often with increased evaporation. Under desert conditions, a wind above 37° C. can add heat by removing this layer of natural insulation. Such a wind can evaporate sweat as quickly as it forms, and hasten dehydration.

Effective clothing is designed to preserve the body air currents and to allow free passage of sweat. The material often insulates from extremes of heat, cold, and wind.

Hair also provides natural insulation. Most heat is lost from the head. Thick hair standing slightly away from the head can provide a difference in temperature between the surface and the skin of as much as 40° F.

Attitude

One last determinant of performance is attitude. Depression and "give-up-itis" almost guarantee failure. But a tremendous will to live can overcome seemingly insurmountable obstacles. Confidence, determination, and serenity are ingredients in such a positive attitude. But bio-cycles, nutrition, and health also contribute.

A young nun became separated from a hiking party. She was wearing slacks, a sweater, a street-type rain coat, and a head scarf. It was rainy and about 45° F. In such a situation, many people fail to survive a single night. This woman spent 3 nights huddled in a crude shelter of boughs on a mountain top. She was found in good shape. Her explanation was that if Christ could survive 40 days in the wilderness, she could manage 3 days. Many people with few resources fare well by combining correct actions with a positive outlook.

Several factors affect the safety of hikers. Some of these factors, such as phenotype and biorhythm, cannot be controlled, but should be seriously considered. Other factors, such as nutrition, physical condition, and stress, can be controlled. However, they must be controlled throughout the hiker's life and cannot be improved at the last minute. The remaining factors discussed here can be readily controlled. So can many others not discussed here, such as good maps, first aid, and emergency supplies. Comprehensive planning should enhance the enjoyment and safety of the whole party.

DISCUSSION

SEARCH

William Syrotuck

Among the organizations available for SAR missions are Mountain Rescue Units, the Civil Air Patrol, the Ski Patrol, Explorer SAR, and the National Jeep Association. Though some are not, several are unified in their efforts. Examples are the Mountain Rescue Association, the National Ski Patrol, and the American Rescue Dog Association. Ideally, all SAR groups would be coordinated.

A lost hiker's location must be predicted, because most agencies lack the resources to search large areas. Bias in this prediction can be reduced by a "decision by consensus." In this method, four or five SAR members write independently their ideas of where the hiker may be. The search director compiles these ideas and averages out a probability. The order of priority determines the search plan. It is important that each contributor work out a probability by himself and commit it to paper. In conversation, people are swayed by authority, experience, rank, or sheer loudness. "Decision by consensus" gives each contributor equal weight in the final decision.

When someone in a climbing party gets lost, a remaining member of the party should be sent to notify the authorities as quickly as possible. If the authorities are far away or the terrain hazardous, two members should be sent together. Remaining members can check trails in the immediate area. But they should re-unite at least once every hour, to ensure that none of them gets lost. Agencies must be notified quickly in order to launch a search properly, even though the subject may be found before the search teams arrive. There appears to be no solution to the financial problem of these searches. Most missions cost far more than an individual can pay.

Parents should tell every child what to do if he gets lost on a hiking trip. Because a toddler can remember very little instruction, a good police whistle should be hung around his neck. The toddler should be instructed that, if he gets lost, he must blow the whistle as long and hard as he can at frequent intervals. Slightly older children, 6 to 9, can carry a small kit containing the whistle and a tinfoil space blanket. These children can build a shelter with the space blanket. The blanket affords some protection from the elements and is easily seen from a distance.

HEAT SURVIVAL

Jean A. Syrocki

Expeditions often involve high risk situations. A desert is obviously a hazard. Heat threatens life whenever prolonged exertion occurs at temperatures above 80° F. Many deserts pose the opposite problem of cold survival at night, and the additional threat of severe, unexpected storms. Other safety hazards include the temperate forest in midsummer; the barren, rocky ridge four hours from water; and the windless gully in direct sunlight.

Persons working in risky environments are prone to the heat syndromes unless acclimatization occurs. During acclimatization, both perspiration and the heart stroke volume increase. In this way, circulatory cooling is improved with less stress on the heart. People in good physical condition already have a better than average heart stroke volume and thus are in less danger than people in poor physical condition. The initial changes of increased perspiration and salt conservation occur after 4 to 7 days of exposure. The optimal adjustments in sweat, salt conservation, and circulation require about 2 weeks of working in the heat at least 90 minutes a day. Longer work periods do not hasten the process, but shorter ones do prolong it. Most people who live in hot climates are not acclimatized for exertion in hot climates.

A number of behavioral adjustments can improve work performance by reducing the accumulated heat load. (1) Work slowly with frequent rests. (2) Utilize available shade, even a pole shadow. (3) Avoid radiant or reflective surfaces. (4) Utilize breezy corners or ridge lines. (5) Drink every 20 to 30 minutes.

Clothing cannot aid acclimatization, but it can enhance comfort and reduce the heat load. In dry climates where the temperature often exceeds body temperature, hikers should shade the head, neck, and limbs. They should increase the evaporation of sweat by wearing loose clothing of absorptive natural fibers. Often clothing must be heavy enough to serve as an insulating barrier against the extreme radiant heat of the environment. When people work hard under such conditions, a wetted layer of clothing next to the skin will help maintain normal body temperatures. Wet thermal cotton underwear is particularly effective. Breezes promote cooling and comfort, but they also promote rapid dehydration.

Hot, humid climates rarely have temperatures above 95° F., because water vapor in the air dissipates much of the sun's radiant energy. Because of this high humidity, evaporative cooling is slight. Hence "there are no clothes like no clothes," or in lieu of nakedness, lightweight natural fibers of loose design. When evaporative cooling is greatly reduced, the only way to keep heat loads manageable is to work very slowly, preferably in

the early morning or late evening.

Natural fibers are superior to pure synthetics. Light colors are better than dark if equally impervious to heat. However, many hot countries have cultural factors affecting the choice of color for clothing. Dark clothes are often woolen or voluminous and therefore provide external insulation.

Limited studies suggest that men and women may not be equally susceptible to heat. It appears that women may tolerate cold somewhat more easily than men. But women seem to be more susceptible to heat for the following reasons: (1) Their smaller stature (on the average) and greater subcutaneous fat (proportionately) make them subject to greater heat loads. (2) Their cardiovascular capacity is smaller. (3) They may not have the sweat capacity of men. (4) They may be subject to greater hormonal and metabolic variations than men. However, there is much individual variation and little relevant data. A woman of appropriate size and physical capability might well perform at the same level as a man.

Supplements of salt and potassium are vital during acclimatization, but only when water is plentiful. Tomato juice has sodium and potassium in the ideal proportion and is available in powdered form for easy packing. Salt may be added to juice or fruit drinks at the rate of 1 teaspoon or less per quart. A high sugar content in drinks may interfere with the absorption of salt in the upper digestive tract. However, if the body is low on sodium, the salt will still be absorbed from the lower bowel between 12 and 24 hours later. Salt tablets are a convenient, though frequently abused source of salt. Each tablet must be taken with a full cup of water and chewed carefully. The better tablets also contain small amounts of potassium, dextrose (an aid to absorption), and calcium carbonate (a buffer for minimizing gastric upset). Daily salt supplements for the average adult should be 2 tsp of salt (6 gm), or 10-12 salt tablets (5-6 gm), or 3 cups of tomato juice (6 gm). Persons who sweat profusely may need to double these amounts.

Extra potassium can be obtained by inclusion of high potassium foods in the diet. Most meats are especially good sources (.4 gm (4 oz). So are nuts (.4-.7 gm/3.5 oz) and bananas (1.3 gm/medium size). Other sources are dried apricots, raisins, dates, melons, and french fried potatoes.

Hikers should drink one cup of water every half hour when at all possible. Work efficiency is thereby enhanced and risk of thermal injury reduced. In very dry areas, water in the backpack should have priority over food. Hikers may also "tank up" by drinking up to two quarts of water before starting a journey. Most of this water will be available as sweat for a few hours before being excreted by the kidneys. Night travel will reduce sweat loss and therefore water needs. Water should not be rationed on a trek. It is carried better inside the body than outside. At 100° F., a man can travel about 20 miles on a gallon of water.

Work in the heat definitely requires high-energy foods. A well-balanced diet is the usual practice. But if water is in short supply, it should be combined with carbohydrates, not with protein. Nitrogen from protein requires extra water for excretion.

Children are decidedly more vulnerable than adults to an increased heat load because of less cardiovascular ability. Salt and water should be replaced according to a child's body weight. Water replacement is seldom a problem. Usually children have fewer delayed-gratification mechanisms than adults. If they have free access to their own water bottle, they will take frequent sips whenever their mouths feel vaguely dry. Adults unaware of a child's high risk status create a problem by imposing their own regimen onto children.

DISCUSSION

HEAT SYNDROMES

Jean A. Syrotuck

A film reviewed the symptoms and management of four common heat syndromes: heat syncope (or fainting), heat cramps, heat exhaustion and early heat stroke.

Several points were made concerning the treatment of these syndromes: 1) Recovery from manageable forms of heat exhaustion and heat stroke likely involves several hours to a day, 2) The severe nausea of heat exhaustion poses a problem for salt and water replacement, possibly requiring the use of anti-emetic suppositories (if the party has them). Small frequent sips of cool water are often well tolerated, and in this instance buffered salt tablets would be better than salty liquids, 3) Control of heat stroke may require more ingenious methods including soaking hair and clothing completely and placing the victim in a breezy location using people or suspended clothing to provide shade. As a last resort, when water is scarce, urine could be used to wet clothing. (Wet cotton in a breeze has more cooling power than wet bare skin.) Fatal heat stroke is often preceded by hallucinations and delirium, followed by unconsciousness. The terminal event seems to be a severe disturbance of the clotting mechanism of the blood with multiple small hemorrhages (petechiae) in the skin and throughout most of the major organs of the body.

Those persons most at risk are the unacclimatized working in the heat. Certain other factors create additional risk, so much so that these people should not work in intense heat. These are: very small stature, obesity, poor physical conditioning, and a variety of medical conditions that: 1) interfere with circulation–cardiovascular disease, renal disease, marked anemias; 2) interfere with sweating–extensive skin disease, sunburn, certain drugs (atropine, anti-perspirants); 3) increase fluid and salt loss–vomiting, diarrhea, alcoholism, cystic fibrosis; 4) increase heat production–fever, metabolic disorders.

Dehydration occurs when water lost via urine (minimum obligatory volume–.5 liters) and sweat (4-12 liters* per day) is not replaced. Symptoms are primarily darkened, scanty urine and prominent thirst (with some fatigue or lightheadedness) occurring often on the first day of exposure. This condition may quickly lead to heat stroke with persistent exertion. The main problem lies in that man is the only animal that does not automatically drink enough to replace total water lost. Even when water is plentiful a person may undergo "voluntary dehydration" over a period of several days as small daily deficits accumulate. Better drinking habits can be learned, including the ability to drink as much as two quarts in one draft. Temperature of the water is not important, but taste often affects the volume taken.

Salt losses--sodium (Na), chlorides (Cl), and potassium (K) in particular–result when

*1 liter approximates 1 quart, 3 grams = 1 teaspoon.

unacclimatized persons exert themselves in hot environments. The kidneys try to conserve urinary loss of Na via production of the hormone aldosterone, but are unable to conserve K which is readily excreted in urine even when a deficiency exists. While aldosterone can reduce Na losses in urine, it has no effect on the loss of Na and Cl lost in sweat which can exceed the usual daily intake of 10 grams by an addition 5-15 gms.* The first symptoms (muscle cramps and fatigue) may appear at the end of the first day, but the extreme fatigue, weakness and nausea of heat exhaustion more often appear after the second day of exposure. While acclimatization is taking place, supplements of salt must be used, but once acclimatization is completed, then generous dietary Na is sufficient.

Recent reports on K show that anyone undergoing prolonged or strenuous exercise is gradually losing K. When sweat losses (about 1-4 gms./day) are added to this, and the normal daily excretion, then many persons working in the heat are undoubtedly deficient in K. Some nutritionists feel that the average daily intake in the American diet (4 gms) is somewhat on the low side of optimal, particularly when our diets are so high in NaCl.

The symptoms of K deficiency are not easily differentiated from those of NaCl but include postural hypotension, and especially muscle weakness and fatigue sometimes accompanied by personality changes such as irritability. Dietary supplementation is extremely important and should be continued after acclimatization. (See Heat Survival Section re methods of supplementing salts.)

Heat rash usually occurs on areas of the body that are persistently wet by perspiration. Loose clothing of absorbent materials and good air circulation that promote drying of sweat usually prevents this problem. Cool evaporating water compresses will often help clear it up.

Swollen ankles or "deck ankles" involve edema of the feet and ankles and occasionally the hands. This is common in the unacclimatized and females. The cause is thought to be poor circulation and may reflect the action of aldosterone trying to conserve sodium. It is common after long standing or sitting. It can sometimes be the result of overdoses of salt tablets by overzealous neophytes. The greater frequency in women probably coincides with their pre-menstrual tendency to retain extra tissue fluid. In young healthy persons it should not inhibit their activity and may even be somewhat improved by moderate exercise. In older persons it may well indicate inefficient cardiac or renal function and should serve as a warning that exertion in the heat could have serious consequences. Swollen ankles usually disappear after four to seven days of exposure and coincide with the first measurable changes of acclimatization.

Sensitivity or allergies to sunshine (more accurately ultra violet light) can pose a problem. People with true sun allergies cannot tolerate sun for more than short periods even at cool temperatures without the benefit of sun screen creams. (The common variety of sun lotions are not adequate.) The more usual episode of hive-like blotches in response to high sun exposures is more often attributable to two other causes: 1) a photo dermatitis reaction resulting from certain soap residues (such as hexachlorophene) left on the skin or 2) a usually transient reaction to preservatives commonly found in skin lotions (parabens being one) which have been shown to be sensitizing agents. Use of simple soaps and hypo-allergenic creams is recommended. For those persons who are very susceptible to sun burn, ingenuity of dress to the extent of large floppy brimmed hats, long sleeves, cotton gloves and possibly a bee-keeper's net may be necessary. Good dermatologic sun screens work well but are very difficult to keep on sweating skin. Tropical seas and high altitude snow fields have exceptionally high ultra violet exposure.

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*1 liter approximates 1 quart, 3 grams = 1 teaspoon.

RESCUE AND SEARCH

William Syrotuck

The terms rescue and search refer to different aspects of aid to mountaineers. A hiker may break a limb or collapse from heat or cold. Such an accident necessitates a *rescue.* A hiker may also get lost, and thus require a *search.* A rescue mission comprises a small group of climbers with specific skills. Searches involve greater manpower and quite different skills.

Rescue units maintain the skills of mountaineering and technical evacuation. Some agencies, like the National Park Service, have developed their own rescue cadres. A few sheriffs have full time rescue forces. But nationwide, most mountain rescue units work on a volunteer basis.

Equipment has improved recently. Winches are now hydraulic or powered by a chain saw with a capstan head. But the size and weight of some winches restrict their use. The most useful mechanical device is the helicopter, responsible today for most evacuations. Of course, the helicopter requires piloting skills, plus knowledge of mountain weather and wind and the effects of high altitude on lift capabilities. Rescue medics riding in the helicopter administer aid at the accident location and on the return trip. Although the helicopter has changed rescue procedures, traditional skills must be maintained because of weather limitations.

At one time, searches were performed by hastily gathered groups from nearby areas. In many cases, local volunteer fire departments handled searches, and in eastern states, many fire departments still do. In western states, units of 100 to 150 people have been organized and trained specifically for searches. They have refined their administration and techniques, and added communications.

Tracking dogs, like the traditional bloodhound, have weather and time limitations. Newly introduced searching dogs have no such limitations and can deal with a wide variety of missions. Today visual trackers of the Border Patrol can determine which direction lost hikers have taken. The new technology of search planning makes use of computers and mathematical probabilities.

In 1969, the National Search & Rescue Plan came into effect at the federal level. The announced purpose was to "provide an overall SAR plan for effective utilization of all available facilities" and to "include provision for the control and coordination of all types of SAR." The Air Force was charged with coordination and unofficial "support." Thus military resources, notably helicopters, became available for searches and rescues.

In most states, the county sheriff is legally responsible for SAR missions, but in some states, the state police are responsible. NPS controls missions in the national parks. The Forest Service and BLM have relinquished to the county sheriff their responsibilities. In

some areas, agencies and volunteers have mutual understandings. Because of these differences, hikers should acquaint themselves with the local SAR system and learn how to give a quick alert. Recently some states have introduced a state SAR coordinator as a liaison between government agencies, the Air Force, local sheriffs, NPS, and volunteers. A few states support the accident insurance of volunteers. Occasionally they offer compensation for lost or damaged equipment, and even for gas and oil used on a mission.

There are still some problems in SAR work. Volunteer units lack consistency. Though some are highly skilled, others are not. The quality of resources coming to a hiker's aid depends on the area. One of the best places in which to get lost or have an accident is a national park. At the federal level, complex policies make it difficult to implement a mission properly. At the county level, searches and rescues have a low priority in law enforcement. Sheriffs' departments find very little time and money for them. Most departments do not have trained SAR directors. SAR problems are further compounded by a lack of definition. (Is the missing teenager a runaway?) Some sheriffs think that hunters deserve to get lost, and do little to find them. Agencies are not consistent in their responses to SAR missions.

The reasons for a rescue mission are obvious and physical. An accident has happened because of inadequate equipment, mismanagement of the climb, medical breakdowns, or changes in weather. But the causes of a search mission are less clear. A hiker may get lost for any number of physical or psychological reasons. For instance, he may take a short cut, his trail may be obliterated, weather changes may confound him, he may lack his companions' abilities, he may be fatigued, senile, or inquisitive.

Across the country, there are many more search missions than rescue missions. The American Alpine Club records rescues, but search missions are not recorded on a national basis. In 1974, the AAC recorded 26 deaths due to climbing accidents. But an estimated 400 to 500 people die each year because they get lost. Of these, a very large percentage die within the first 24 hours. Hypothermia is the most common cause.

Obviously the public requires more information about survival skills and the hazards of bad weather. When lost in the backwoods, remember these rules:

(1) Avoid panic. If you find yourself running, you are already starting to panic.
(2) Stay put, and conserve your energy.
(3) Protect yourself from the elements with some sort of shelter.

For a precaution, every climbing party should obey the following injunctions:

(1) Tell someone your route, destination, and time of return.
(2) Take adequate equipment. Be prepared for a change in weather.
(3) Have a compass and good maps of the area.
(4) Learn about hazards of weather and terrain.
(5) Stay on trails and intended routes. Avoid short cuts.
(6) Pay attention to your own weaknesses.